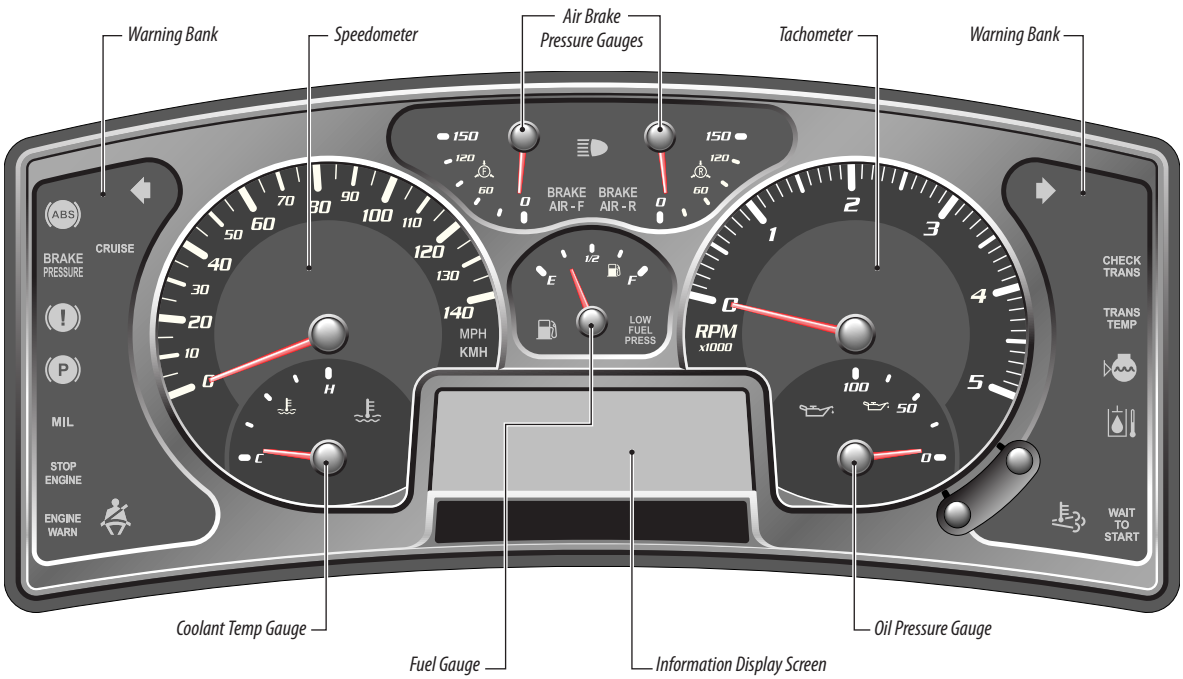
Overview

The Blue Bird All American instrument cluster uses all electronic analog guages with stepper motor technology coupled to a microcontroller that provides the necessary electrical control. In addition to gauges, this ACTIA® manufactured instrument cluster includes an LCD display panel known as a Message Display Center and gauge warning indicators which provide illuminated visual alerts to the Driver.

The instrument cluster receives both analog inputs from such components as the fuel tank sender and instrument panel dimmer switch; binary inputs from brake and directional signal switches; and digital signals from components such as the engine and transmission control modules, via the J1939 and J1587 data buses.

The instrument cluster comes with several modes of operation. The system is in Sleep Mode when the battery power is applied to the cluster with no other activity. In this mode the microprocessor deactivates the power maintain output resulting in low power draws of less than 3mA to support the clock. When the instrument cluster sences a change to an input signal such as turning the iginition key on or turning on the headlights, the cluster wakes up and then decides which mode to enter depending on which input is active. Limited Mode is a stand by mode entered when there is battery power available and the iginition is turned off, but other input signals are requiring the system to operate such as hazard warning lights or brake interlock request. Another mode of operation is the Start-Up Mode. This mode is entered when the iginition is turned on. When the start-up mode is initiated the cluster will go through a functional diagnostic test, if the self-test option is enabled (default). During this test you will see the gauge pointers drive to zero position (pause) then move to half scale (pause) and then move to full scale (pause) before returning to the zero



position, and finaly going to the commanded position. During this time all warning lights will perform a lamp check by turning on for 5 seconds, and the three different audible tones will be checked by turning on for 1 second. During this start-up mode, the microprocessor also monitors all the inputs. If a problem is detected an error message will be displayed and the gauges will wag to flag the communication failure. The Ignition Mode is the normal operational mode of the system and is active as long as the ignition switch is on. When the ignition is turned off the microprocessor will zero all gauges, except the fuel gauge which will remain at its last command position. The Self-Diagnostic Mode is entered through a menu selection. The self-diagnostic tests include the gauges, LCD, warning lights, binary inputs, analog inputs and binary outputs. Detailed specifications can be found in the Message Display Center section of the appendix.

The backlighting on this instrument cluster is adjustable through an internal dimmer. This is done using the two buttons on the face of the cluster. The backlight color can also be changed through the setting and diagnostics menu accessed using the same two buttons on the face of the cluster. Backlight colors are blue, light blue, white, red and green. The white LCD and amber pointer backlights are not adjustable.

The cluster also uses its microprocessor to compute logic required for certain units to function. When the logic is satisfyied, an output is generated and sent to these units to satisfy their operational needs. Units requiring logic outputs include Speed Detect used in the brake interlock system, Seat Belt Logic used for alarms and Lift Authorization used to supply power to deploy the handicap wheelchair lift.

The instrument cluster is a sealed unit with no serviceable parts including gauges, lights and buzzers. If your cluster is found to be defective, it is replaced in whole as a unit.

Appendixes In This Chapter

Appendix 1. My08 Blue Bird Corporate Cluster Functional Specification. This ACTIA publication was created especially for Blue Bird and details the operation of the instrument system including a detailed explanation of the Message Display Center's menus and diagnostic capabilities.

Instrument Cluster Removal

The instrument cluster is designed for easily removed from its housing by means of seven screws around the perimeter of its face. The instrument cluster is not designed for disassembly and is removed as a unit.

1. Turn the iginition switch to the off position and remove the key. Lower the steering wheel to the bottom of its travel.

2. Remove the seven machine screws from around instrument panel's perimeter.

3. Carefully pull the instrument assembly away from the dash housing and tilt face down.

4. Disconnect the electrical connectors from the back of the instrument cluster and remove unit.

Testing a Gauge By Substitution

To help quickly determine if a suspected gauge is faulty, the harness connnector from an adjacent gauge can be temporarily substituted.

1. Label and remove the wiring harness from the gauge in question.

2. Label and remove the wiring harness from an adjacent gauge.

3. Plug the connector from the known "good" gauge into the suspect gauge.

4. Support the instrument cluster in a safe position.

5. Turn the ignition switch to the "ON" position. Start the engine if necessary.

6. Check whether the suspect gauge now indicates a value. If it does not, the gauge may be faulty. If the gauge indicator needle now indicates a reading, the original malfunction is probably not due to a faulty instrument panel harness. A gauge test can determine if the gauge itself needs to be replaced. There are other test and troubleshooting techniques available in Appendix 1. Refer to the manufacturer's service manual for instructions regarding signals originating from the engine ECM or transmission TCU. Electrical diagrams can also be found in this manual to aid in troubleshooting the entire circuit.

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MY08 Bluebird Corporate Cluster Functional Specification

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	By	Date		ACTIA Ref.	Revision
Written			**MY08 BBCC**	**110715**	**F**
Reviewed			**Specifications**		
Approved					
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Revision Table				
Rev	By	Date	Software	Description
0	R Parks	11-26-2007	1110940v00_01	Original Draft; Out for comment
1	R Parks	11-29-2007		Updated per comments from Kevin Decker (10.6.1, 7.1.2.3, 7.1.2.4, 7.1.2.5,)
2	R Parks	01-16-2008		Changed tachometer to 5000 rpm (5.1.2), Removed Stop light warning light (5.3.12), Removed stop light inhibit configuration bit (7.3.6), Added Brake Interlock priority message (7.1.3.25), Removed retarder warning light (5.3.11), Added retarder priority message (7.1.3.26), Added source address to retarder message (6.5). Changed engine shutter solenoid activation level (5.5.2) Removed range inhibit warning light (5.3.8), Added range inhibit priority message (7.1.3.27), Added Trans fluid life / Trans fluid filter / Trans service priority messages (7.1.3.28, 7.1.3.29, 7.1.30, 6.5)
3	R Parks	02/12/2008		Added Seat belt warning light & audible alarm (10.6.1, 5.3.18), Added device auto detect feature, Assigned LED designators to all warning & indicator lights (5.1, 5.3), Changed symbol references (5.3.1, 5.3.2, 5.3.4, 5.3.10). Added screen shots to LCD parameters. Added suspension air to the set up menu. (7.3.7)
4	R Parks	02/27/2008		Replaced the "m & t" button references with "lower & upper" (All), Removed the remote dimmer input (10.6.1), Added dimmer adjustment to the LCD menu (5.2 & 7.2.3), Added scroll description (7.1), Added suspension air screens (7.1.2.5 & 7.3.7), Added Transmission & ABS diagnostic screens (7.28 & 7.29), Added self test screen (7.3.3)
5	S Myers	3.6.08		Section 10.6—Updated the Cluster Connector Pinout table to match the hardware. Fuel level moved to pin 34, All designations from pin 11- pin 17 moved down one pin. Hi Hydraulic Oil Temp/Hyd Brake Fail moved down to pin 17. All designations from pint 22 – pin 25 move down one pin. Pin 25 changed to spare. Seat belt moved to pint 32. Added a little more description to the pins. Added wakeup designation column for clarity on Hardware or Software configurable wakeup. Also added a column for individual connector pinout for clarity.
				Section 7.27— Corrected the Engine Diag display to show the J2012 information instead of the SPN/FMI for GM only. Section 7.28—Corrected the Trans Diag display to show the J2012 information instead of the SPN/FMI.
				Section 5.1—Added stepper motor designators to each gauge for clarity on location
				Section 5.1.4—Changed scale type to linear and max scale to be 100 psi to match the dial. Also corrected direction to be CCW to match dial
				Section 5.1.7—Corrected trigger to be for rear air instead of front air. Probably a cut/past error.
				Combined all indicator lights into single table in section 5.3 for clarity
				Section 7.2—corrected some of the menu item numbers as they were off by one.
				Section 5.1.6—Corrected gauge direction
				Moved and restructured Brake Interlock logic tables. Removed No Brake Interlock table. Removed Stop lamp as it is not used anymore to show Brake peddle depressed.
				Added a note to Drive mode screen section to show that Quad 2 has no user configuration and will be skipped when navigating between quadrants.
				Added feature programming section to show config bit
				Moved 1939 Table to the back
6	S Myers	3.21.08		Changed Test panel binary inputs to work with the Input module spare binaries.
				Added reference to Bus Type config byte to brake interlock logic tables to show reference to BBCV.
				Corrected the configuration bytes
				Added SA 16 to retarder message detail in 1939 table
				Corrected the logic of turning odo on with ignition off. It is not done by dimmer anymore, but by headlights or button push
				Added Engine ID feature detail

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				Renamed section 6.5.5 to throttle interlock instead of brake interlock
				Updated Plug and play section description to remove roll call references
				Added priority message for data link missing
				Removed 1850 and GMLAN references from Allison transmission in section 2.
				Section 6.6--Corrected pin references and clarified message broadcast and trigger information for all sent messages.
				Corrected all section referencing pin 25 as service brake to be pin 24
				Removed duplicate info on Lift Authorization logic flow chart that referenced sent messages.
				Updated Dial face backlight color descrip with color percentages based on WCC application
				Section 8--Changed Backlight setting feature to DIMMER and added a backlight color selection feature. Need new screen shot.
				Updated all pin out references to match table.
7	S Myers	4.1.08		Updated lift authorize flow chart for clarification
				Updated missing suspension air pin info as it is the same as front air but only in hydraulic busses.
				Added description to backlight section for clarity
				Moved brake interlock logic flow chart and modified for clarity
8	S Myers	4.2.08		Modified section 9 to change the way brake system and its option setting are configured.
				Updated section 8.7.5 and 8.7.6 to match the new brake system config and option settings.
9	P English	4.11.08		Sections 7.1.1-7.1.5 changed all screen shots to reflect change in quadrant 2. Ammeter if available will now be displayed on line with voltage, current gear will now always have its own line, and depending on active options quad 2 will adjust from 2 to 3 lines as appropriate.
10	S Myers	5.12.08		Finished updating all screen shots for display configurations, messages and menus
				Moved Data link out of instrument diag submenu and restructured for clarity
				Updated all screens in Setup and Diag menu to take advantage of the large screen and stay consistent in navigation features.
11	S Myers	5.15.08		Modified Setup menu to be Configuration menu to clear up confusion between this and the diag and setting menu.
				Updated section 4.1.1 by changing dimmer to headlight for ODO limited mode trigger and added the buttons
12	S Myers	6.12.08		Section 4.2.1 Added a little better description of how long the clusters stays in Limited mode when wakeups are used.
				Section 5.3—Clarified and corrected Park Brake lamp function in the table.
				Section 5.3—Removed Beep 1 from Wait to Start to match A3 multigauge function
				Section 5.3—Added Amber Lamp to Check trans DM1 trigger to match A3
				Section 5.3—Added Amber Lamp to Low Coolant DM1 trigger to match A3
				1939 message table—updated EBC1 to show SA of 0B instead of 11 as all of these are represented in HEX.
				1939 message table—updated the SA for all sent messages to 17 for same reason. This matches A3 function.
13	S Myers	6.17.08		Out dented Audible alarm section 5.4 to be section 6 and clarified definition of alarms.
				Added more description to section 5.3 for associated displays and warning alarms and how they are acknowledged
				Referenced High Exhaust temp Lamp trigger and alarm to be the same as the High Exhaust temp Display message.
				Corrected seat belt alarm in lamp table
				Corrected Data sources for MIL and LOW FUEL PRESSURE lamps in lamp table
				Out dented binary output descriptions for clarity
				Removed duplicate Brake Interlock flow chart in section 9.1.4
				Added A3 only reference to Brake interlock logic flow chart in section 8.6.5
				Defined Brake interlock logic in section 9.1.3.3 as the display logic for BBCV only.
				Added Throttle Interlock message reference to lift authorization Flow Chart for clarity
				Moved Brake Interlock flow chart to message sent section for clarity

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				Removed LOW FUEL PRESSURE binary trigger from the warning light table and from the warning bank input table per John Williams statement that CUMMINS ISLG is the only CNG we support and that is triggered with the voltage on pin 10 of the cluster.
				Corrected audible alarms associated with warnings per Michel markups
				Changed byte 0 bit 7 of config table from unused to clock mode
14	S Myers	6.19.08		Corrected connector pinout to show 1939 on pins 3&4 and GMLAN on pins 5&6
15	S Myers	6.25.08		Updated Cruise control lamp function to use States instead of Active to match current A3 functionality that was never documented before per Michel.
16	S Myers	6.26.08		Section 9.1-- Changed how Quad 1 is toggled and how Quad 3 and 4 are navigated between to make the commonly used odometer much easier to toggle and the lesser used Parameter (Quad 3) the default selection and the even lesser used clock (Quad 4) the only one that requires more that one button push and the only one to require the double button push to get to.
				Section 9.2—Updated instruction on toggling between quad 1 display options and how to reset trip odo.
				Section 9.3—corrected verbiage in quad descrip for 2A to say PRNDL instead of requested gear.
				Section 9.4.1—Added more description to how quad 3 is changed by the end user
				Section 9.5—Added description on how quad 4 is changed by the end user
17	S Myers	7.1.08		Section 3—Added note to provide updated drawings of the dials to BB if a spec change effects the dial art Per John Williams request to do so.
				All references to Park Brake input PIN 22 changed from AH to AL. Per John Williams request
				Section 5.4—Changed seat belt audible alarm from beep 1 to beep 3 per John William's request for a unique beep for seatbelt logic. Also changed trigger to only reference flow chart in section 5.4.1
				Section 5.4.1—Changed seat belt logic to actuate if the input is high (unbuckled) instead of Low (buckled) per John Williams
				Section 6.1—Added Beep 3 tone definition for seat belt as continuous with same frequency as Beep 2 per John Williams.
				Section 8.6—Removed water in fuel from messages sent per John Williams
				Section 9.4.2—corrected brake interlock display function reference to reference the correct table in section 9.4.2.1
				Section 9.4.2—Changed retarder applied audible alarm to NONE per John Williams
				Section 10.6.4—Added reference only comment to screen shots for I/O status
18	S Myers	7.10.08		Section 9.4.2—Updated headlight alert logic to closer match A3 function per Michel's notes.
				Section 6.1—Updated tone definition to change beep to freq and both beep 1 and beep 2 repetition to 2Hz per Michel's notes on how the software actually works and to closer match A3
B	S Myers	7.10.08		All changes for this rev are additions original project requirements
				Section 1—Added FMVSS/CMVSS 101 requirement per John Williams
				Section 4—Added Brake interlock request limited mode note per John Williams
				Section 5.4—Removed triggers and alarms for High Hydraulic Oil temp as it is no longer required per John Williams
				Section 5.4—Changed Hydraulic Brake Failure international icon to text BRAKE PRESSURE per John Williams (was originally specified to be BRAKE SYSTEM but was inadvertently changed to the international symbol after rev 2 of the spec. Some time after this was implemented in Alpha it was requested that the symbol be moved down and its place be taken by text BRAKE PRESSURE so that both were available on one dial)
				Section 7.1—Modified Speed Detect output logic per John Williams. Added the Brake interlock request and Battery Controlled Lift Config requirements. Added section 11.10 for this new config.
				Section 12.2—Added byte for the above mentioned Battery Controlled Lift Config.
				Section 7.3—Added Brake Interlock request input and Battery Control Lift Config to Lift Authorize logic per John Williams.
				Section 8.6.2.1—Modified Brake interlock logic per John Williams
				Changed PIN 25 from spare to brake interlock alarm BIN AL per John Williams

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				Changed PIN 36 to brake interlock request BIN AL per John Williams. This will be a wakeup
				Added section 4.2.3 to describe limited mode for Brake interlock request wakeup per John Williams.
				Changed PIN 27 from Alternator to Spare per John Williams
				Changed PIN 33 from Spare to Lift door not open per John Williams
				Changed PIN 35 to Brake Interlock Set/locked per John Williams
				Section 8.6.1—Added brake interlock request to service brake message sent trigger per John Williams
				Section 9.4.2—Changed Alternator Fail PIM logic per John Williams
				Section 9.4.2—Removed Hi Hydraulic Oil Temp PIM per John Williams
				Section 9.4.2—Removed Hydraulic Brake Fail, Low Front and Rear Air PIM's per John Williams
				Section 9.4.2—Changed Water in fuel PIM data and logic to 1939 per John Williams
				Section 13—Added FMVSS/CMVSS 101, 105, 135 per John Williams
				Changed Water in Fuel SA to 0 and from TX to RX in the 1939 message table per John Williams
				Section 14.8—Removed MIL input as it is no longer needed and moved all other inputs except test inputs to cluster connector per John Williams
		7.14.08		Changed section 8.6.2.1 to say Throttle interlock instead of Brake interlock to reduce confusion between this and section 9.4.2.1 brake interlock message logic matrix.
				Section 9.4.2.1—updated the brake interlock PIM logic matrix per John Williams. Added Interlock Alarm and vehicle speed. Changed displays to flashing and added different alarms per John Williams.
				Section 11.7—Updated bus type config description as the Brake interlock logic is now not exclusive to BBCV but will be used on D3 as well.
				Section 7.1—Added park brake set to Speed detect logic per John Williams
				Section 14.6—Added Fast Idle input to PIN 27 as BIN AL
				Section 8.6—Added Fast Idle message
				Section 10—Added an Air Brake PSI view screen to setting and diagnostic menu for Pretrip Brake Inspections per John Williams
				Moved BRAKE interlock Alarm from pin 25 to pin 27 and moved Fast Idle from 27 to 25 and made it AH per John Williams
		7.22.08		Section 1—Added "in writing" to criteria for standard deviation by customer per John Williams
				Section 4.2.3—changed the AH to just Active to avoid duplicate info and any confusion between Active and Analog.
				Corrected spelling in D404 row of lamp table
				Section 5.4.1—Added park brake decision to logic of seatbelt per John Williams
				Section 6.1—Added a little more description to the Audible alarm section to clarify the numbers in the table.
				Section 7.3—Moved battery control Lift config decision to come after Ignition decision per John Williams
				Section 8.6.2.1—corrected the verbiage to only refer to throttle interlock. Removed reference to A3 as this applies to both A3 and CV per John Williams. Also updated 11.7 to say that bus type config has no effect on application any more.
				Section 9.4.2—Changed Alternator Fail to have acknowledgeable alarm.
				Section 9.4.2—Corrected WIF SPN from 197 to 97.
		7.24.08		D402—ABS alarm changed to self cancel in 5 sec per John Williams
				Section 7.3—moved "in neutral gear" decision above park brake set and changed how it interacts with batter cntrl lift decision per John Williams
				Section 9.4.2—chanced Lift not Stowed alarm and Battery Voltage alarm to Beep 1/for 5 sec per John Williams
				Section 9.4.2—added detail that both turn signals at the same time do not apply to turn signal warning logic per John Williams
				Section 9.4.2—Changed WIF alarm to be acknowledgeable
				Section 9.4.2—Removed the ignition of portion of the headlight reminder logic, per John Williams. I also added the 2 min duration as this is how it currently works.
				Section 9.4.2—Changed duration of alarm for ATC, DPF and High exhaust temp to 5 sec per John Williams

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				Section 9.4.2—Change alarm for Range Inhibit, Trans oil life, filter and service to NONE per John Williams
				Section 9.4.2.1—changed alarm durations for several of the alarms per John Williams
		7.30.08		Section 12.2.2—Corrected Engine Type bit values and descriptions to match software
		8.15.08		Removed Hydraulic designation from D404 and added comment to trigger to only use this if configured as English. Added D405 for Metric brake fail function. Corrected Air gauge warning lamps to text instead of symbol. All of which to satisfy the changes made to the dial per John Williams.
		8.25.08		Section 9.4.2.1—Added note that brake interlock is NOT acknowledgeable per John Williams.
				Section 6.1—Added details of general acknowledgement and reoccurrence of alarms per John Williams.
		9.4.08		Section 5.4—Per previous documentation received from BB on how the engine should react to PTC messages I updated Stop engine and Engine Warning lamps to work with the DPF message.
				Section 9.4.2.1—I added Scenario numbers to each row of the Brake Interlock display table for clarity.
				Section 12.2—Allocated another bit to the Engine Type config setting to allow for future unknown CAT or Cummins Engines to register with Engine ID message.
		9.5.08		1939 Table—changed the SA for retarder message to 0F, 10 and 29 based on engine and transmission specifications.
				Section 11.3—Removed the requirement for Beep 2 to sound for turn signal If turn signal click config is disabled
				Section 7.1—Reconstructed Speed Detect output flow chart and added notes for clarity. (corrected Ignition on decision outcome 9/8/08)
				Section 7.3—Reconstructed Lift Authorization output flow chart and added notes for clarity
				Section 8.6.2—Slightly modified the verbiage in Throttle interlock message description logic to clarify that it is sent during Lift Authorization output active.
		10.14.08		Added comment about fuel gauge initial position in section 4.3
C	S Myers	10.27.08	110940v01_17	Section 11 & 12—added detail to make certain configurable feature only accessible by diagnostic tool after 25 mi. Per Jim Halpin
				Section 11.7—Added function to the Bus Type Config to invert the Park Brake and Fast Idle binary input logic for BBCV per Jim Halpin
				Added PIN 36 AL to Wait to start for BBD3 and BBCV per Jim Halpin
		11.10.08		Section 5.4—Split D406 Park Brake lamp to double as Brake Fail when configured as Metric. Spec only change for clarification, software is correct.
D	S Myers	12.11.08	110940v01_18	Added Section 9.4.1.1 to describe calculation and display of the Average Fuel Consumption resettable trip. This was to give BB a resettable trip average fuel per John Williams.
				Section 10.6—Changed clock set menu timeout from 5 sec to 15 sec per John Williams
				Section 5.2—Changed how the dimmer adjustment works Per John Williams
				Section 5.4—Added SPN 65000 as a trigger for ENGINE WARN lamp for Gateway support.
				Section 8.6.1—removed brake interlock request as a requirement for the service brake message to be sent per John Williams
		12.16.08		Section 11.11—Added a configuration to the Config menu to Enable or Disable the seatbelt logic. This includes “auto detect” feature to enable the logic if input becomes active. Used Byte 1, bit 7 of config bytes.
		12.17.08		Section 5.1.1—Swapped MPH and KMH LED designations for dial face art change. Software needs updated as well.
E	S Myers	1.9.09	110940v01_18	Section 5.4—Park brake lamp/alarm logic changed to shut off after 2 min. to match current A3 gauge logic. This is a document only change and confirmed by John Williams.
		1.20.09		Section 9.4.2—Added 30 sec delay to Alternator Fail and Low Voltage Error triggers per John Williams.
F	S Myers	2.6.09	110940v01_21	Section 8.2—Added final gateway spec info as well as more definition for device ID

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				messages.
				Section 11.8—Added notes to clarify what changes with GM 1850 config
				Section 9.4.1—Added display info to show which Parameters were not available when configured for GM 1850
				Section 9.4—Added note that Quad 3 defaults back to Trans Temp on ignition cycle. This is not a software change but additional info for the spec and confirmed by John Williams.

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1. PURPOSE

This document is the design specifications for the development of a corporate cluster for Bluebird Bus Corporation. Initially to be used on the D3 and CV bus lines.
The instrumentation is based on gauges with stepper motor technology, married to a microcontroller that provides the necessary electrical control. Circuit provisions are included to assure compliance with SAE J1455 "in cab" standards and Bluebird electrical SP13 environmental specification.
All gauges and indicator or warning lamps as well as displays are to comply with FMVSS/CMVSS 101 standards unless deviation is approved by the customer in writing.

2. SCOPE

This document covers the operational specifications of the instrument panel and gauge system for use in Bluebird school buses. Engine, transmission, and ABS systems used in this application are listed in the table below:

Engines	Transmissions	ABS Systems
Cummins ISB07 (Diesel) / ISC07 (Diesel) / ISLG (J1939)	Allison 2000/2500 / 3000 (1939)	Wabco Hydraulic Systems (J1939)
GM 8.1L (Gas) ECM (J1850* & GMLAN)		Bendix EC30 Air Systems (J1939)
CAT C7 (Diesel) (J1939)		Bendix EC60 Air Systems (J1939)

*Note: J1850 communications facilitated through Actia J1850 to J1939 converter module (Actia # 106622)

3. RELATED DOCUMENTS

For more detail on functional or visual details of this instrument system, the following documents must be consulted:

- 110763 Dial face with Air Gauges-If spec change effects graphics, updated art must be supplied to the Customer for approval and documentation on their end.
- 110764 Dial face without Air Gauges- If spec change effects graphics, updated art must be supplied to the Customer for approval and documentation on their end.

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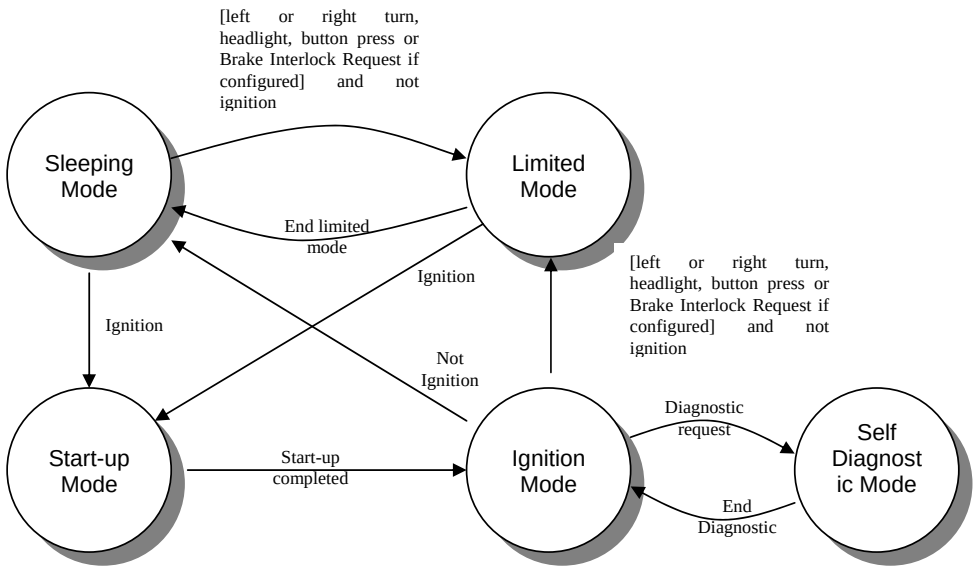
4. MODES OF OPERATION


[left or right turn, headlight, button press or Brake Interlock Request if configured] and not ignition
Sleeping Mode
Limited Mode
End limited mode
Ignition
Ignition
[left or right turn, headlight, button press or Brake Interlock Request if configured] and not ignition
Not Ignition
Diagnostic request
Start-up Mode
Start-up completed
Ignition Mode
Self Diagnostic Mode
End Diagnostic

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4.1. Sleep Mode

If battery power is applied to the system with no other activity, it will be in sleep mode. When the system is in Sleep Mode the microprocessor is stopped.

4.1.1. POWER SUPPLY

The system exits Sleep Mode when one of the wake-up inputs becomes active. When the cluster wakes up, it first begins to control the power supply by activating the power supply maintain output. It then decides, depending on which wake up input is active, what mode must be entered. When the system goes back to sleep after the deactivation of the wakeup input, it simply deactivates the power supply maintain output.

4.1.2. LIN DEVICES

All LIN devices will remain awake for 10s after loss of wakeup. The master will stay awake for 4 seconds after loss of IGN and 10 seconds after loss of any other wakeup.

4.1.3. CLOCK

The clock will remain awake in the background as long as battery power is applied. It will only display on LCD when in Limited or Ignition mode.

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4.2. Limited Mode

The system runs in limited mode when battery power is available, the ignition input is not active but other input signals are requiring the system to operate. The system exits limited mode when the ignition becomes active or the input signals that caused the system to wake-up become inactive.

4.2.1. DISPLAY ODOMETER & CLOCK IN LCD

The odometer and Clock is readable with the ignition off when the Headlight input is Active or Mode or Trip button is pressed. The cluster will go back to sleep mode if the Headlight input is not active or 15 sec after the mode or trip was pressed.

4.2.2. HAZARD WARNING LIGHTS

The right and left turn icons are operational with the ignition off when the hazard lights are turned on (right and/or left turn binary inputs high).

4.2.3. BRAKE INTERLOCK REQUEST

When this input is Active the cluster power supply will wake up only to check the Battery control lift config and depending on the setting will either carry out the logic for the outputs as described in section 7 of this document or go back to sleep.

4.3. Start-Up Mode

The ignition binary input is used to sense if the key switch is on or off. The cluster enters start-up mode when the ignition is on. If the start-up self-test option is enabled, the system will go through the functional diagnostic tests described in the start-up self-test option section.

If the self-test option is disabled the gauges should drive to zero, with the exception of fuel which remains at its last commanded position, then default to actual values received by data buss messages/senders at startup.

All warning lights will perform a lamp check by turning on for 5 seconds and then go out. After lamp check, active warning lights will turn.

The cluster will determine which data buses are connected and which devices are present. Error messages will display if a data bus is missing or a device that had been previously found is now missing. If the data bus should fail, a communications error should be displayed on the LCD, and the gauges will wag to flag the communication failure.

4.3.1. START-UP UP SELF-TEST OPTION

The start up self-test is an option enabled through the setup menu. The factory setting for this option is enabled.

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4.3.1.1. Gauges

Gauge pointers will drive to zero position. The pointers will then drive up scale, pausing at ½ scale, before completing the sweep to full scale. The pointers will then return to zero position before moving to the commanded position.

4.3.1.2. LCD

During the up scale sweep of the pointers, the LCD will turn all its segments on for one second, off for one second and then display the opening message. The opening message is the Bluebird logo followed by the software ID, complete with revision level.

4.3.1.3. Warning Lights

Starting at the up scale pointer sweep, all warning lights will turn on for 5 seconds and then go out. Active warning lights will turn on when the gauges go to their commanded position.

4.3.1.4. Audible Alarm

The audible alarm will sound three different tones for one second each during the up scale swing of the pointers.

4.4. Ignition Mode

The ignition mode is active as long as the ignition switch is on.
The ignition is the normal operational mode of the system.

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If the ignition line goes low the micro will zero all gauges, except the fuel gauge which will remain at its last commanded position, and store any data to the EEPROM before turning the supply off.

After storing the data, the system goes to sleep mode after a delay of approximately 4 seconds.

4.5. Sleep Mode

When the system is in sleep mode the clusters microprocessor goes into low power mode and draws less than 3 mA to support the clock function.

The system exits sleep mode when one of the wake-up inputs become active. When the cluster wakes up, it first begins to control the power supply by activating the power supply maintain output. It then decides, depending on which wake up input is active, what mode must be entered.

When the system goes back to sleep, it simply deactivates the power supply maintain output.

4.6. Self-Diagnostic Mode

The self-diagnostic mode is entered through a menu selection using the LCD. Diagnostics is only available when the Park Brake is set.

The self-diagnostic includes the following tests:

- Gauges
- LCD

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- Warning Lights
- Binary Inputs
- Analog Inputs
- Binary Outputs

Detail specifications are found in the Message Display Center section.

4.7. Test Panel Mode

The test cluster mode can only be activated through Actia provided software. When selected, the software is configured as a production chassis test fixture. The functions below describe the difference in operation for this mode:

1) An active Binary Input on WB PIN 6 will configure the cluster for Chassis with System Air (If it is not active it will be configured for a Hydraulic system)
2) An active Binary Input on WB PIN 7 will configure the cluster for Chassis with Applied Air (front and rear applied air).

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5. IGNITION MODE

5.1. Gauge Display

5.1.1. SPEEDOMETER

Data Source	Stepper	Range	Movement	Scale	Indicator Light
J1939 - PGN65265 GMLAN -TBD	M404	187°	CW	Linear 0° = 0 187° = 140	MPH – D426 K/mh – D427

Note: Scale units (MPH -Km/h) scale will be noted though dead front indications on the speedometer.

5.1.2. TACHOMETER

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
J1939 - PGN61444 GMLAN - TBD	M401	187 °	CW	Linear 0° = 0 RPM 187 ° = 5000 RPM	None	None	None	N/A

5.1.3. FUEL GAUGE

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
Diesel - CL_Pin_34 Gas - CL_Pin_34	M403	90°	CW	Linear 0° = Empty 90° = Full	Amber – FMVSS 571-101 Table 2 Fuel Level (D428) Fuel Pressure (D429)	On if fuel ≤ 12.5% Then off if fuel ≥ 18% (Gas / Diesel)	Beep 1	Yes/5 min. Reoccur
CNG - CL_Pin_10					Amber – Text “Low Fuel Pressure” (D429)	On if fuel ≤ 1.6Vdc Then off if fuel ≥ 1.7Vdc(CNG)		

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5.1.4. OIL PRESSURE GAUGE

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
J1939 - PGN65263 GMLAN - TBD	M402	90°	CCW	Linear 0° = 0 PSI 90 ° = 100 PSI	Red – FMVSS 571-101 Table 2 (D430)	J1939 - DM1SPN100 GMLAN - TBD	Continuous 1	Yes/5 min. Reoccur

COOLANT TEMPERATURE GAUGE

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
J1939 - PGN65262 GMLAN - TBD	M405	90°	CW	Linear 0° (C) = 100°F 90° (H) = 260°F	Red – FMVSS 571-101 Table 2 (D425)	J1939 - PGN65262 GMLAN - TBD	Continuous 1	Yes/5 min. Reoccur

5.1.5. FRONT AIR GAUGE

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
CL_Pin_11	M407	90°	CW	Linear 0° = 0 PSI 90° = 150 PSI	Red – text "BRAKE AIR-F" (D431)	On when front air ≤ 65 PSI Then off when ≥ 72 PSI	Continuous 1	No

5.1.6. REAR AIR GAUGE

Data Source	Stepper	Range	Movement	Scale	Warning Light	WL Trigger	WL Alarm	Alarm Acknowledge
CL_Pin_12	M406	90°	CCW	Linear 0° = 0 PSI 90° = 150 PSI	Red – text "BRAKE AIR-R" (D432)	On when Rear air ≤ 65 PSI Then off when ≥ 72 PSI	Continuous 1	No

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5.2. Backlighting

The gauge backlighting will be turned on when the backlight (CL_Pin_19) input is active.

Dimming of the backlight is done using an "internal dimmer" which is controlled using the buttons on the cluster. If the park brake is set the dimmer can be accessed through the diagnostic menu.

If the park brake is not set, and the Headlight input is active then the up an down buttons will automatically become the dimmer adjustment. In this state, if Trip or Odometer access or access to any other quadrant is needed, both buttons must be pressed and they will temporarily return to normal operation.

Once adjusted the setting is stored in the EEPROM.

5.2.1. GAUGES

The gauge backlight can be selected by the end user. The selected color is controlled through the setting and diagnostics menu using the buttons on the cluster. Once adjusted the setting is stored in the EEPROM.

Colors	R %	G %	B %
Blue	0	0	100
Light Blue	0	47	100
White	62	100	91
Red	100	0	0
Green	0	100	0

5.2.2. LCD

The LCD backlight is not selectable by the end user.

Color
White

5.2.3. POINTER

The pointer backlight is not selectable by the end user.

Color
Amber

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5.3. Warning Bank Indicators

5.4. Lamp General Detail

The lamps detailed below are either indicator lights activated to show the engagement of some chassis function or warning lights to show a fault in a particular chassis function.

Some warning lights have an alarm associated with them. This alarm will be one of several preset speaker profiles. See alarm section for profile details. Alarm and duration are referenced for each lamp. If no duration is listed the alarm will continue until the fault is gone.

Some warnings have an associated LCD Warning message that will be displayed along with the warning light. See the message display section for specifics on those messages.

All warnings with associated alarms/display messages can be "acknowledged". If the user acknowledges the warning by pressing the ***top button***, the display will go back to the previous screen and the alarm will stop, but the indicator lamp will remain active. The alarm/display will reocure if fault still exists at text ignition of in a predetermined time frame if noted.

Pos	Function	Color	Graphic	Data Source	Trigger Logic	Alarm/Duration
D401	LEFT TURN	GRN 527nm	SAE J1362 # 14.9	CL_Pin_21	ON Active High	Click 1
D413	RIGHT TURN	GRN 527nm	SAE J1362 # 14.9	CL_Pin_23	ON Active High	Click 1
D406	PARK BRAKE	RED 610nm	SAE J1362 No. 12.6	CL_Pin_22 BIN_AL	On steady if Active and IGN is ON	NONE
					Flash at 1Hz for 2 min then Off if not active & Ignition Off Flash at 1Hz if Active & Ignition on & ≥ 3 MPH	Beep 2 when Lamp is on or flashing
	BRAKE FAILURE (Metric)			CL_Pin_17_AL	On steady if Active	Continuous
D433	HIGH BEAM	BLU 469nm	SAE J1362 # 14.1	CL_Pin_20	ON Active High	None
D410	STOP ENGINE	RED 610nm	Text "Stop Engine"	J1939 - DM1RedStopLamp GMLAN – TBD	ON for SPN ANY_FMI ANY	Continuous 1
				PGN64892	Value 100 lamp is on steady	See DPF PIM
D424	WAIT TO START	GRN 527nm	Text "Wait To	J1939 - PGN65252	ON = 01	NONE

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			Start"	PIN 36	ON Active Low	
D416	CHECK TRANS	RED 610nm	Text "Check Trans"	J1939 - DM1CheckTransLamp GMLAN – TBD	ON for SPN 2003_ FMI 31 and AMBER Lamp	None
D402	ABS	YEL 590nm	SAE J1362 No. 12.11	J1939 - PGN61441ABS	ON = 01	Beep 1/for 5 sec
D420	HIGH HYDRAULIC OIL TEMP	RED 610nm	SAE J1362 No. 11.6	Not required	Not required	Not required
D404	BRAKE FAILURE (Engllish)	RED 610nm	Text "BRAKE PRESSURE"	CL_Pin_17	ON Active Low (only if configured for English units)	Continuous
D418	LOW COOLANT LEVEL	YEL 590nm	SAE J1362 No. 9.9	J1939 - DM1LowCoolantLamp GMLAN – TBD	Flashing at 1Hz for SPN111_ FMI 1, 11, 18 and AMBER Lamp	Continuous /until acknowledged
D417	HIGH TRANS TEMP	YEL 590nm	Text "Trans Temp"	J1939 - DM1HighTransTempLamp GMLAN – TBD	ON for SPN 177_ FMI 15	Continuous /until acknowledged
D423	HIGH EXHAUST TEMP	YEL 590nm	Engine Manufacturer Defined	J1939 - PGN64892_SPN3698	Same as Display Message	Same as Display Message
D412	ENGINE WARNING	YEL 590nm	Text "Engine Warn"	J1939 - DM1CheckEngLamp GMLAN – TBD	ON for SPN ANY_FMI ANY	Continuous /until acknowledged
				when the idle shutdown (PGN65252Shutdown.) becomes active.	indicator is illuminated and will flash on and off at a 3Hz Idle shutdown will have priority on J1939 over engine warning.	
				SPN 65000	FMI M18	
				PGN64892	Value 011 lamp will flash in sequence with DPF display Flash	See DPF PIM
D408	MIL	YEL 590nm	Text "MIL"	Not Used	Not Used	Not Used
D403	CRUISE	GRN 527nm	Text "Cruise"	J1939 - CruiseActive GMLAN – TBD	ON = Anything except 000 or 111	None
D411	SEAT BELT	RED 610nm	Modified SAE J1362 No. 8.14	CL_Pin_32	see seat belt logic section below	Beep 3
D405	BRAKE FAILURE	YEL 590 nm	Symbol ISO2575 B.01	CL_Pin_17	ON Active Low (only if configured for Metric units)	Continuous
D407	SPARE	RED 610nm	TBD	TBD	TBD	TBD
D409	SPARE	YEL 590nm	TBD	TBD	TBD	TBD
D414	SPARE	RED 610nm	TBD	TBD	TBD	TBD

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D415	SPARE	RED 610nm	TBD	TBD	TBD	TBD
D419	SPARE	YEL 590nm	TBD	TBD	TBD	TBD
D421	SPARE	YEL 590nm	TBD	TBD	TBD	TBD
D422	SPARE	RED 610nm	TBD	TBD	TBD	TBD

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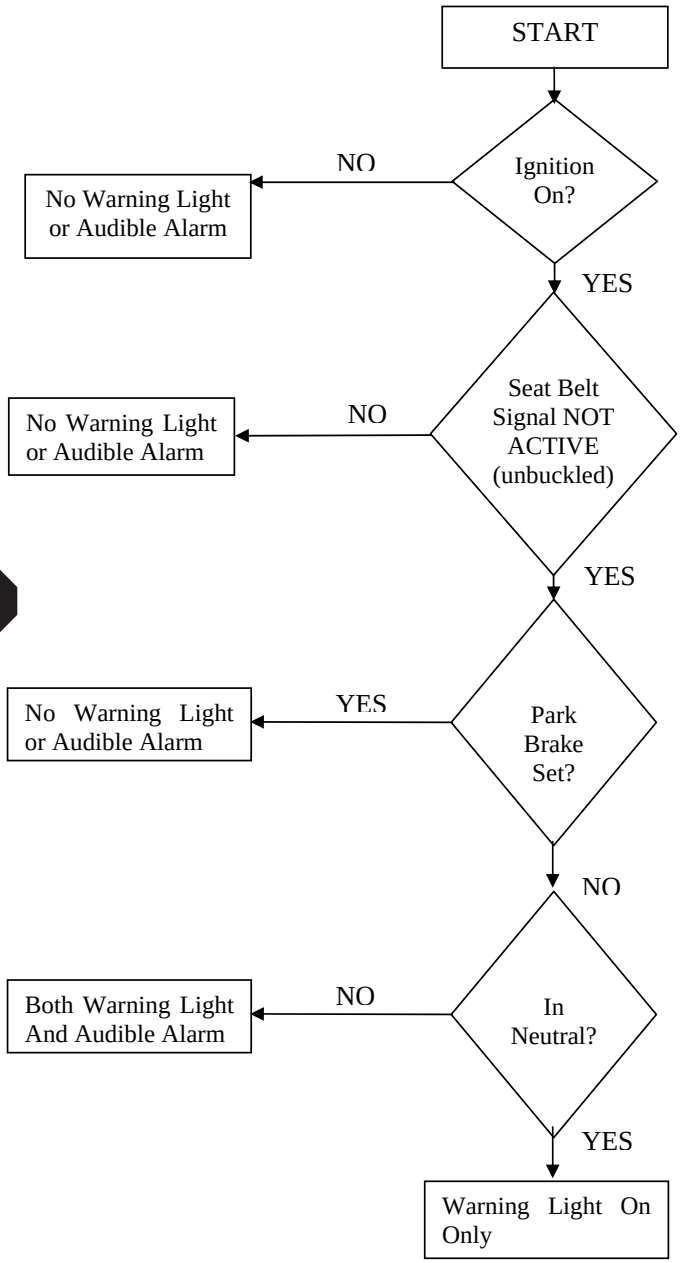
5.4.1. SEAT BELT LOGIC

This warning light & audible alarm are active when the requirements are met, shown in the flow chart below:



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6. AUDIBLE ALARM

6.1. Tone Definition

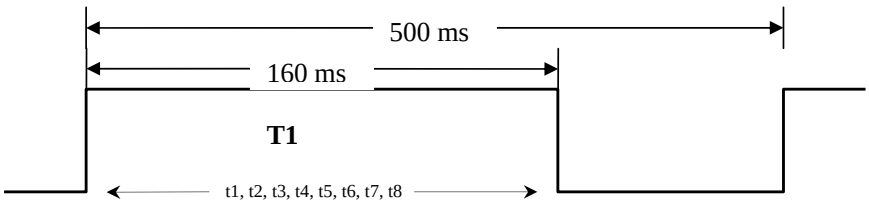
The following table details the available alarms mentioned throughout this document. These will be referred to by their Audible Alarm name throughout this document to define audible alarms for specific functions. The Frequency of the alarm is detailed below. The Period is shown as the "ON" time repeated tones and then the Repetition describes how often the tone is repeated.

Continuous and Click alarms cannot be acknowledged unless otherwise stated. All Beep Alarms will have a 5 min reoccurrence when acknowledged unless otherwise stated.

Audible Alarm	Freq.	Period	Repetition
Continuous 1 (Buzzer)	2.8KHz	N/A	Continuous (see section 11.1 for timeout config detail)
Beep 1 (Alarm)	2.0KHz	160 ms	2 Hz
Beep 2 (Chime)	2.8KHz	160 ms	2 Hz
Beep 3 (Seat Belt)	2.0KHz	160 ms	Continuous
Click 1 (Relay)	See below	See below	See Below

6.1.1. TURN SIGNAL CLICK

Turn signal Click				
T1	**On** Click (Hz)	Duration (ms)	**Off** Click (Hz)	Duration (ms)
t1	10,000	160	10,000	160
t2	6,200	80	2,800	80
t3	2,400	10	2,400	10
t4	10,000	160	10,000	160
t5	6,200	150	6,200	80
t6	3,600	80	2,800	40
t7	920	40	10,000	160
t8	6,200	150 830	6,200	80 770



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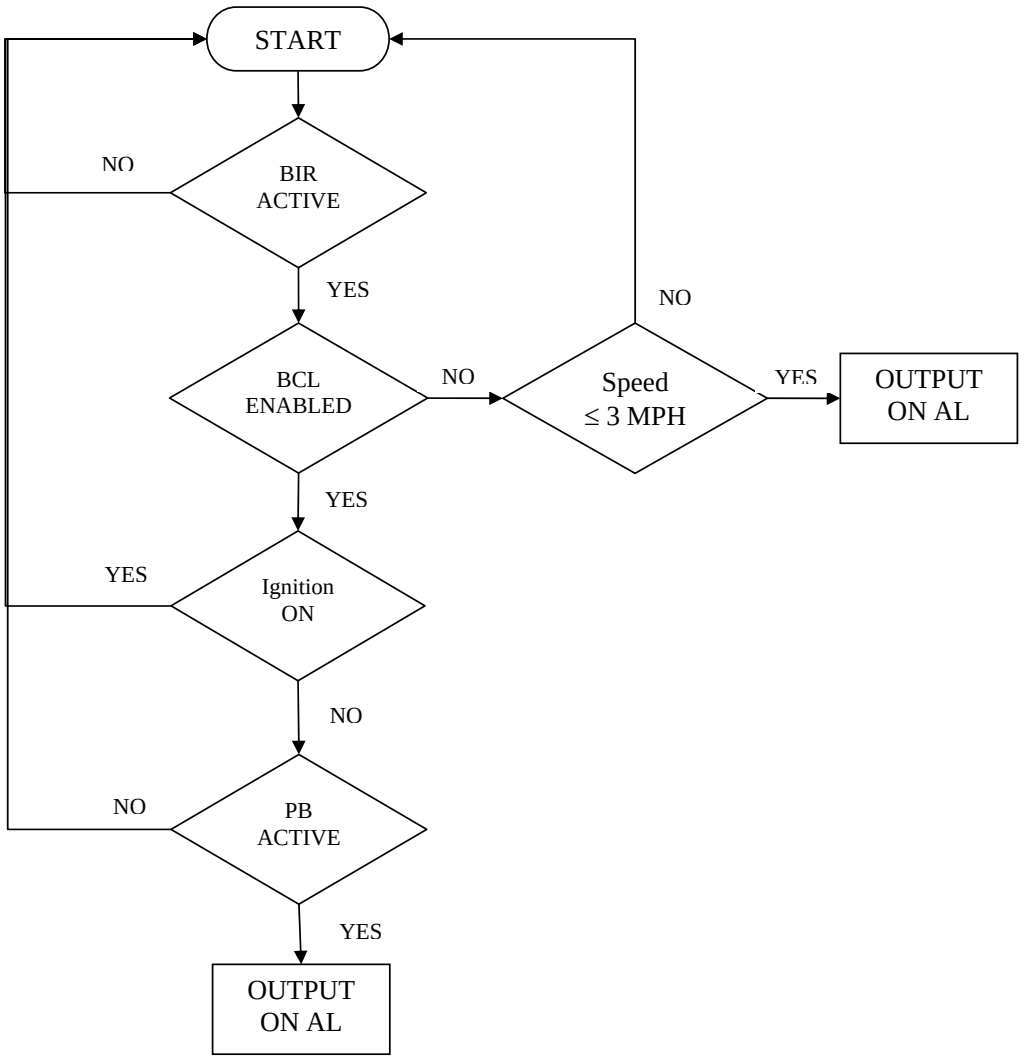
7. BINARY OUTPUTS

7.1. Speed Detect

Speed Detect output will be active according to the logic below. The display will be on with ODO and Clock and display the message "SPEED DETECT ON" while active when ignition is off.



Note: BIR=Brake Interrupt Request; BCL= Battery Control Lift Config; PB=Park Brake

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7.2. Shutter Solenoid

This binary output is a low side drive output and is normally active. For the logic listed below this output will become inactive.

Cummins Engines:
Inactive output when PGN 65262 Byte 1 has a value of ≥ 180°F and PGN 65270 Byte 3 has a value ≥ 100°F or engine is not running.

CAT Engines:
Inactive output when PGN 65262 Byte 1 has a value of ≥ 180°F and PGN 65270 Byte 3 has a value ≥ 140°F or engine is not running.

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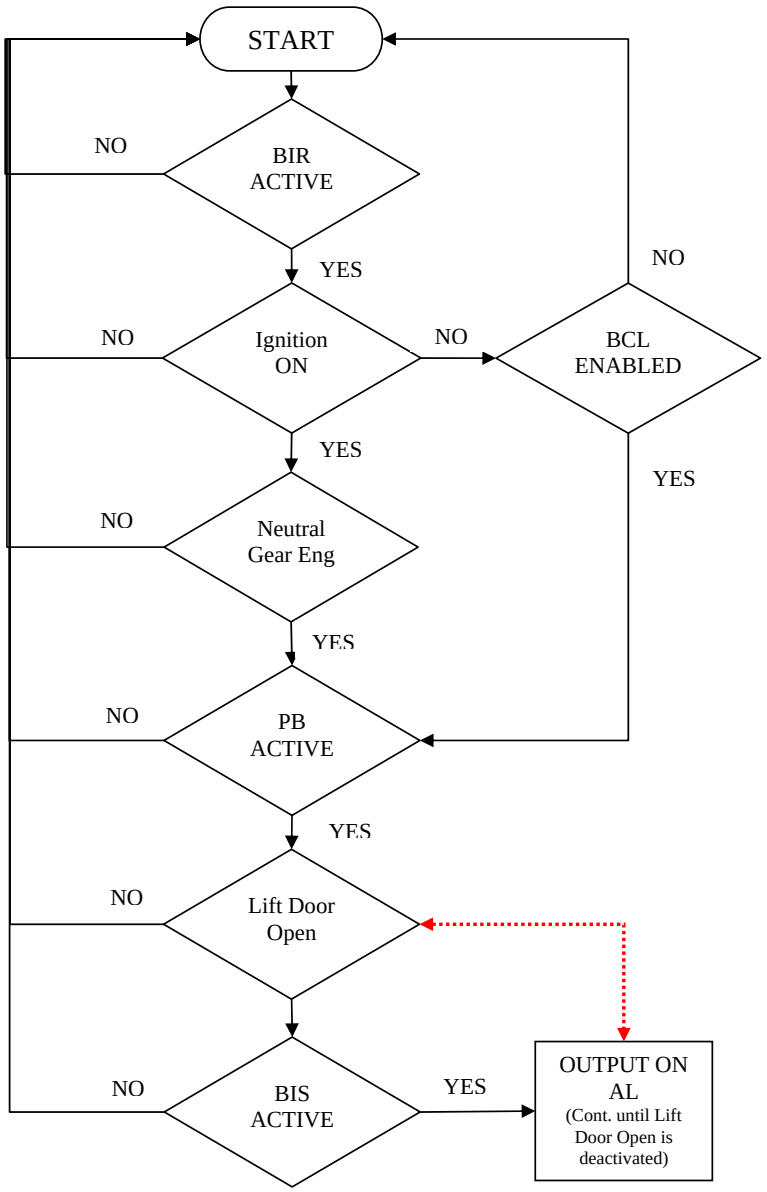
7.3. Lift Authorization

Lift Authorization output will be active according to the logic below. The display will be on with ODO and Clock and display the message "LIFT AUTHORIZATION ON" while active when ignition is off.



Note: BIR=Brake Interrupt Request; BCL= Battery Control Lift Config; BIS=Brake Interlock Set; PB=Park Brake

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8. COMMUNICATION

There are two communication channels for data transfer between the vehicle and the speedometer. One channel for CAN 2.0B/GMLAN (Controller Area Network) and a second channel for CAN 2.0B/SAE J1939 (Controller Area Network).

All frames transmitted by the speedometer on J1939 are continuously sent at the standard broadcast rate for the frame using source address (SA) 23dec (17h).

The cluster communicates via the LIN bus to slave devices. The slave gauges are updated every 80mSec.

8.1. J1939 Auto Detect Function

The cluster will monitor the J1939 at start up and will look for Engine (SA00h), Transmission (SA03h) and ABS (SA0Bh) systems.

8.2. Engine ID

To allow the cluster to be configured to multiple engines, the cluster will request engine make & model for J1939 protocol engines by sending a request for PGN65259 SPN 586 and 587 (BAM). The responses expected will be as follows.

	Engine Cummins		
ID Byte (ASCII)	Cummins ISB	Cummins ISC	Cummins ISL G
1	C	C	C
2	M	M	M
3	M	M	M
4	N	N	N
5	S	S	S
6	*	*	*
7	6	6	6
8	B	C	L
9			
10	u	u	U
11	0	0	0
12	7	7	7
13	D	D	G
14	0	0	0
15	6	8	8
16	7	3	9
17	*	*	*
18	*	*	*
19	*	*	*

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	Engine Caterpillar		
ID Byte (ASCII)	CAT C7	CAT C9	
1	C	C	
2	T	T	
3	R	R	
4	P	P	
5	L	L	
6	*	*	
7	C	C	
8	-	-	
9	7	9	
10	*	*	
11	*	*	
12	*	*	
13			
14			
15 16 17 18 19			

	Engine GM 8.1L (1850)		
ID Byte (ASCII)	Cummins ISB		
1	G		
2	Y		
3	*		
4	X (last digit 1)		
5	X (last digit 1)		
6	*		
7	*		
8	*		

GM 8.1L LTG propane engine will communicate on 1850 and for this application the Gateway module will be used so if the Gateway is present on the 1939 data bus, the cluster will assume the GM propane engine is used. See 111702 specification for general Gateway message support details.

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	Transmission		
ID Byte (ASCII)	Allison 2000	Allison 2500	Allison 3000
1	A	A	A
2	L	L	L
3	L	L	L
4	S	S	S
5	N	N	N
6	*	*	*
7	M	M	M
8	D	D	D
9	2	2	3
10	0	5	0
11	0	0	0
12	0	0	0
13	*	*	*
14	*	*	*
15	*	*	*

	ABS Bendix (Air)		
ID Byte (ASCII)	EC60-sta	EC60-pre	
1	B	B	
2	N	N	
3	D	D	
4	W	W	
5	S	S	
6	*	*	
7	E	E	
8	C	C	
9	6	6	
10	0	0	
11	-	-	
12	S	P	
13	T	R	
14	A	E	
15	*	*	
16	*	*	
17	*	*	

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8.3. Plug and Play Function

The cluster keeps historical list of slave (LIN) devices attached and continuously verifies that all devices are present while in Ignition mode. When a new device is found it is added to the list. If a device is found missing, a Data Link Warning message will be sent to the LCD but is NOT removed from the list. Devices can only be removed from the list through the diagnostic menu.

8.4. J1939 Communication Errors

If a parameter is not received by J1939 for 5 seconds it will be flagged as missing. Missing LCD information will display a "-" and missing gauge information will be signaled by wagging the pointer from dial end to dial end. A missing J1939 data bus will be announced in the LCD.
If a LIN parameter is missing for 5 seconds the gauge will wag the pointer from dial end to dial end and flash the warning LED.

8.5. GMLAN Communication Errors

If a parameter is not received by GMLAN for ?? seconds it will be flagged as missing. Missing LCD information will display a "-" and missing gauge information will be signaled by wagging the pointer from dial end to dial end. A missing GMLAN data bus will be announced in the LCD.
If a LIN parameter is missing for 5 seconds the gauge will wag the pointer from dial end to dial end and flash the warning LED.

8.6. Messages Sent

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8.6.1. SERVICE BRAKE

Input Data Source	Message Trigger	Message Sent
CL_Pin_24	BIN AH	J1939 - PGN65265_SPN 597 = 01 GMLAN – TBD
See Lift Authorize Logic	If trigger above is NOT active or lift authorize conditions are met	J1939 - PGN65265_SPN 597 = 00 GMLAN – TBD

8.6.2. THROTTLE INTERLOCK (A3/D3 ONLY)

Input Data Source	Message Trigger	Message Sent
See Lift Authorize Output and Throttle Interlock Logic flow charts	The throttle interlock message is sent to the engine when the lift authorization output is active (section 7.3) or Throttle Interlock conditions (Section 8.6.2.1) are met.	J1939 (CAT)- PGN65264_SPN 980 = 01 J1939 (Cummins)- PGN61441_SPN 972 = 01 GMLAN - TBD

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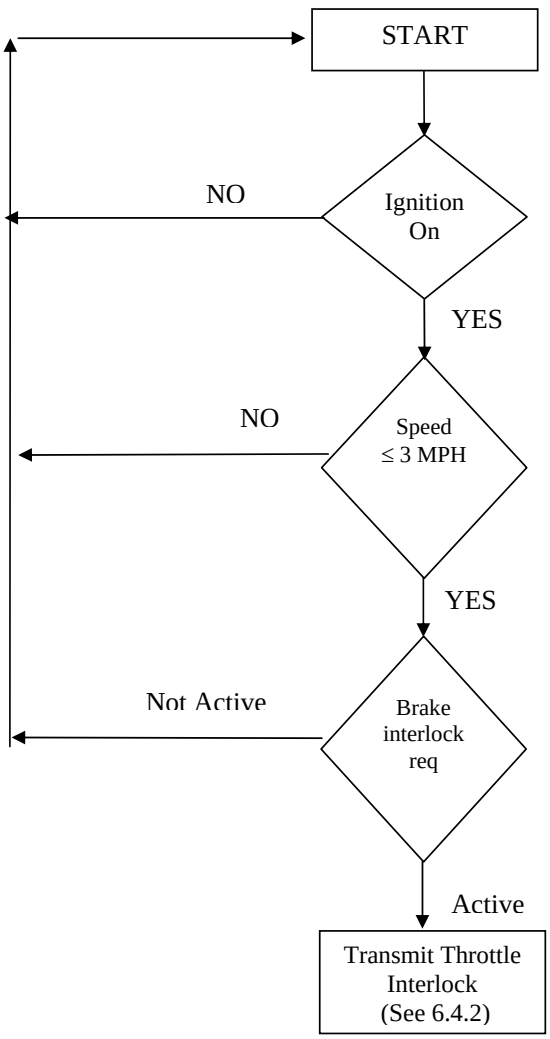
8.6.2.1. Throttle Interlock

The function of the throttle interlock message is shown in the flow chart below:



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8.6.3. PARK BRAKE

Input Data Source	Message Trigger	Message Sent
CL_Pin_22	BIN AL	J1939 - PGN65265_SPN 70 = 01 GMLAN - TBD

8.6.4. FAST IDLE

Input Data Source	Message Trigger	Message Sent
CL_Pin_27	If this input is active AND Park Brake is set AND in Neutral Gear	J1939 (CAT) - PGN65264_SPN 980 = 01 J1939 (CAT) - PGN65264_SPN 979 = 01 J1939 (CMNS) - PGN65264_SPN 979 = 01 GMLAN - TBD

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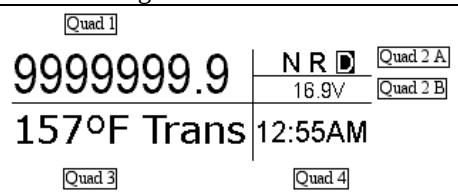
9. MESSAGE DISPLAY CENTER

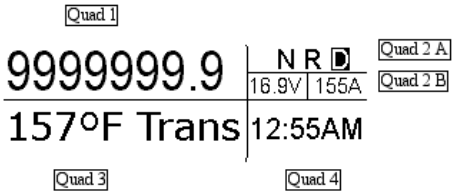
9.1. Drive Mode Screen

During normal operation the LCD displays in 4 quadrants. The user can activate and navigate between quadrant 3 & 4 by pressing and release the ***lower*** button to highlight quadrant 3 and then press and release both buttons to select quadrant 4. Quadrant 1 is controlled only by the4 upper button and quadrant 2 has no user configuration so it cannot be selected. To toggle though the available selections for the active quadrant press the ***upper*** or lower button to toggle up or down respectively. Below are examples of the possible drive mode screen configurations depending on quadrant 2 related chassis features.

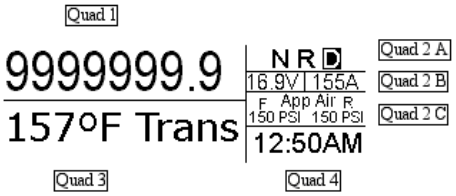
Configured without Ammeter



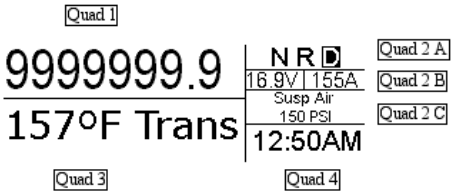
Configured with Ammeter



Configured with Ammeter and Applied Air



Configured with Ammeter and Suspension Air



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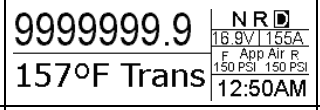
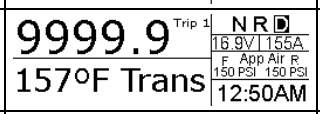
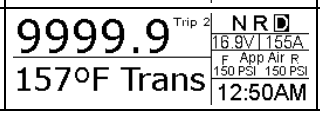
9.2. Quadrant 1

Quadrant 1 is dedicated to the odometer or the trip odometers. This quadrant is always 169 pixels wide by 37 pixels tall. The user can toggle between the odometer, trip 1 and trip 2 by simply pressing and releasing the top button. Two trip odometers are available and will be designated T1 & T2 when displayed. To reset T1 or T2 simply press and hold the top button while that trip distance is displayed.

Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Odometer	J1939 – PGN62265_SPN 84	XXXXXX X.X				
Trip1	J1939 – PGN62265_SPN 84	XXXX.X				
Trip2	J1939 – PGN62265_SPN 84	XXXX.X				

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9.2.1.1. Odometer Logic

All odometers have a resolution of 0.1 mi/km. Leading zeros are only displayed in the 1's position. The vehicle distance is calculated every 80 msec. and stored within the cluster in kilometers. It can be displayed in miles or kilometers. The odometer reading will be displayed when the ignition switch is off by activating the headlights or pressing either button on the cluster.

9.2.1.2. Odometer Accuracy

Accuracy of the odometer value is dependant on two (2) main variables. 1) The algorithm in the speedometer for calculating distance, and 2) the speed value transmitted by the ECM. The algorithm has been designed and written to calculate the distance with the accuracy and resolution necessary to exceed SAE recommendations. The distance is calculated every 80 msec. to reduce error during any rapid speed change the vehicle might make. The speed data is dependant on the calibration parameters for tire size and axle ratio being properly entered into the ECM. These are the same parameters necessary to have the ECM properly calculate the vehicle speed and distance value. Testing has indicated that the algorithm will calculate mileage within ±0.07% of actual based on the speed received. This far exceeds the SAE recommended ±0.3% found in SAE J1226.

9.2.1.3. Normal Shutdown

The odometer value is stored to the EEPROM at each 1-kilometer increment (0.62 mi) and when the ignition switch is turned off. The value is stored to 1/100 of a kilometer resolution (33 ft) using a 4-byte memory location within an array. Each store is made sequentially to one (1) of eight (8) locations in the array so at any point in time the last eight (8) values are maintained. Each value stored is verified at the time it is saved. Multiple store attempts to a location will be made if necessary, and if not successful, the memory location will be tagged as bad. The "precount" that is used to increment the odometer every 1/100th km is also saved. The "precount value is 115200.

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Therefore, our internal resolution is 1/11520000th of a km or 0.003385827 inches. This value is stored on power down and recovered on power up.

9.2.1.4. Abnormal shutdown

If there is battery power loss at the speedometer prior to turning the ignition off, an abnormal shut down will occur. The odometer value, when power is restored, will return to the last kilometer increment value saved; i.e. the last XXX.0 kilometer rollover. Therefore, the **maximum** distance lost by an abnormal shutdown will be 0.9 km (0.56 mi). Battery loss that occurs >4 seconds after turning the ignition off will NOT result in an abnormal shutdown. The occurrence of an abnormal shutdown during the life of a vehicle should be rare.

9.2.1.5. Durability

The EEPROM store routine will allow for a minimum of 4 million store cycles. The design will accommodate 200 key-offs per day, 260 days per year, for 20 years plus 1.609344 million kilometers (1,000,000 mi) which could be seen if the vehicle is used on a delivery route, with a 50% safety factor (200*260*20+1,609,334) = 2,649,334+51% = 4,000,494 store cycles. An error recovery scheme is implemented that will allow the odometer value to be recovered should a hardware failure in one of the EEPROM memory cells occur.

9.2.1.6. Error Recovery

The error recovery algorithm will check each stored value to determine if the values are in sequence (low to high) and 1 km or less apart. If this condition is found no errors are present and no further action is required. If a value is found to be out of order or greater than 1 km from the others, the software will identify the largest value in the group with the proper sequence and use that value.

In the unlikely event the speedometer fails in such a way that the odometer value cannot be displayed, the factory, in most instances, will be able to recover the stored value.

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9.2.1.7. Maximum Reading

The odometer will stop incrementing when the maximum display count is reached. Therefore, the value will not rollover to zero and continue incrementing but will freeze at 9,999,999.9.

9.2.1.8. Service Programming

If replacement of the cluster becomes necessary, the actual vehicle mileage may be programmed into the odometer using Actia proprietary software. The mileage may be incremented, but not decremented, using this software.

9.2.1.9. Service Gauges

Replacement clusters will be shipped in a mode that allows the installer to preset actual vehicle distance, thus eliminating the need to “tag” the vehicle. Documentation on how this mode works can be found in Actia document # 104426.

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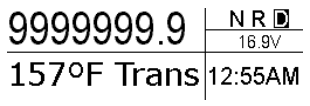
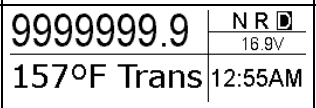
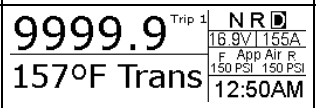
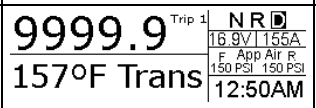
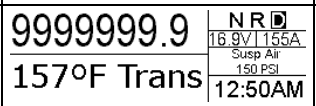
9.3. Quadrant 2

Quadrant 2A/2B/2C is configured based on active chassis features. Quad 2 is 80 pixels wide independent of the configuration. Quad 2A is dedicated to the PRNDL and will always be 20 pixels high. Quad 2B is dedicated to Voltmeter, and Ammeter (if configured active). Depending on the presence of air configurations, 2B will be 17 pixels high (no air) or 15 pixels high (with air). Quadrant 2C will display only if Applied Air or Suspension Air feature is configured active and will be 20 pixels high if present.

Function	Data Source	Text Format	Display Example	Trigger Logic	Display Notes	Alarm/ Duration
Voltmeter	J1939 - PGN65271_SPN 168 or PGN65271_SPN 158 If both are available SPN 168 will be used GMLAN – TBD	XX.XV				
Current Gear	J1939 - PGN61445_SPN 523 GMLAN - TBD	N R D				
Front Applied Air	CL_Pin_13	XXX PSI				
Rear Applied Air	CL_Pin_14	XXX PSI				
Suspension Air (Hyd bus only)	CL_Pin_11	XXX PSI				

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9.4. Quadrant 3

Quadrant 3 is dedicated to the parameters screen and the priority messages. This quadrant is 169 pixels wide by 39 pixels tall.

9.4.1. PARAMETERS

Quad 3 can be configured by the user to display any one of these parameters. The user must press and release the bottom button which will highlight the quadrant in reverse video. Then to toggle the selection you must either press the bottom button or top button to scroll through the possible parameters to display. This Quad will default back to Trans Temp at each ignition cycle.

Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Trans Temp	J1939 - PGN65272_SPN 177 GMLAN – TBD	XXX°X Trans	9999999.9 N R D 16.9V 157°F Trans 12:55AM			
Intake Manifold Temp	J1939 - PGN65270_SPN 105 GMLAN – TBD	XXX°X IMT	9999999.9 N R D 16.9V 155A **150°F IMT** 12:55AM		Not available for GM 1850	
Engine Hourmeter	J1939 - PGN65253 _SPN 247 GMLAN – TBD	XX.X Hrs	9999999.9 N R D 16.9V 155A **8977.4 Hrs** 12:55AM			
Boost Pressure	J1939 - PGN65270_SPN102 GMLAN – TBD	XXXX XXX Boost	9999999.9 N R D 16.9V 155A **5PSI Boost** 12:55AM		Not available for GM 1850	
Instantaneous Fuel Econ	J1939 - PGN65266_SPN 184 GMLAN – TBD	XXXX XXX Inst	9999999.9 N R D 16.9V 155A **12.5MPG Inst** 12:55AM		Not available for GM 1850	
Average Fuel Econ	See section 9.4.1.1 GMLAN – TBD	XXXX XXX Avg	9999999.9 N R D 16.9V 155A **12.5MPG Avg** 12:55AM		Not available for GM 1850	

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9.4.1.1. Average Fuel Consumption Detail

Total Distance (TD)

This is an independent trip odometer dedicated to Average Fuel Consumption calculations and will not be displayed. This distance is calculated using the wheel based vehicle speed (CCVS) in Kmh multiplied by the time traveled. For the trip distance it simply logs this distance from the time of Average Fuel Consumption reset to the current time giving you Total Distance traveled (TD). This data would be stored in the EEPROM.

TD = CCVS * T

Total Fuel Consumed (TFC)

This is the total fuel used value calculated by using the Total Fuel Used (PGN65257_SPN250 SA00) given in L.

This calculation is based on total fuel captured at the last Average fuel reset (TFr) and every 1s after that (TFn). TFC is calculated by subtracting the reset value (TFr) from the current value (TFn). This data would be stored in the EEPROM.

$TFC = TF_{(n)} - TF_{(r)}$

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Average Trip (AT)

This calculation is based on TD recorded since the last AT reset. This data would be stored in the EEPROM.

The AT can be reset if the Average Fuel consumption display is selected for Quad 3. The user will be given a choice to reset or not using the Top button. If the AT is reset the current TFC value will be stored as $TF_{(r)}$. and AFC displayed is set equal to Instantaneous Fuel Economy received from the engine (SPN 184)

AFCr = IFE

Average Calc

At every 1s after the AT reset the following formula will be used to calculate Average Fuel Consumption:

AFC = TFC / TD

This process will continue every 1s until the AVG is reset.

Note : Both Instantaneous and Average Fuel Economy values are stored in EEPROM. After power up both previously calculated values are kept until a next valid calculation occurs. If no message for the fuel is broadcasted than those values will not change. At manufacturing the Fuel Economy values are reset to 0. This can of course be displayed in mpg for English units when converted.

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9.4.2. PRIORITY MESSAGES

Quad 3 content will be replaced by these messages in the event of their trigger logic being satisfied. Some of these messages can be acknowledged by pressing the bottom button which will return Quad 3 to previous display until the recurrence time, next ignition or the trigger logic is not satisfied. If multiple triggers are present, the associated priority messages will cycle every 2 seconds.

Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Engine Comm Fail	J1939 – SA00 GMLAN – TBD	As Shown	9999999.9 N R D 16.9V 155A **No Engine Communication** 12:55AM	Not Available >1s	Message Flashing forward to reverse video at 500msec intervals	None
Trans Comm Fail	J1939 – SA03 GMLAN – TBD	As Shown	9999999.9 N R D 16.9V 155A **No Transmission Communication** 12:55AM	Not Available >1s	Message Flashing forward to reverse video at 500msec intervals	None
ABS Comm Fail	J1939 – SA0B GMLAN – TBD	As Shown	9999999.9 N R D 16.9V 155A **No ABS Communication** 12:55AM	Not Available >1s	Message Flashing forward to reverse video at 500msec intervals	None
Data Link Warning	Historical List of connected devices	As Shown	9999999.9 N R D 16.9V 155A **Data Link Warning** 12:55AM	Missing device that was present	Message Flashing forward to reverse video at 500msec intervals	None
Vehicle Speed Error	J1939 – PGN65265_SPN 84 GMLAN – TBD	As Shown	9999999.9 N R D 16.9V 155A **Vehicle Speed Error** 12:55AM	J1939 data is either N/A or in the error data range	Message Flashing forward to reverse video at 500msec intervals	Beep 1
Engine Door Open	CL_Pin_28	As Shown	9999999.9 N R D 16.9V 155A **Engine Door Open** 12:55AM	Active Low	Message Flashing forward to reverse video at 500msec intervals	Continuous/ Until Fault is gone
Brake Interlock	See Section 9.4.2.1 below	See Section 9.4.2.1 below	9999999.9 N R D 16.9V 155A **Brake Interlock** 12:55AM	See Section 9.4.2.1 below	See Section 9.4.2.1 below	See Section 9.4.2.1 below
Retarder Applied	J1939 – PGN61440_SPN 1667 GMLAN – TBD	As Shown	9999999.9 N R D 16.9V 155A **Retarder Applied** 12:55AM	Value = 01	Message Flashing forward to reverse video at 500msec intervals	None

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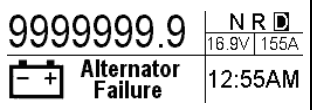
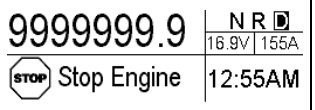
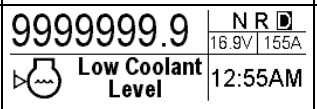
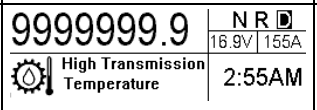
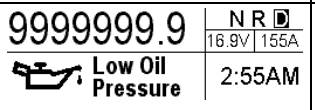
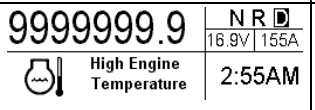
Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Alternator Fail	Internal Logic	As Shown		RPM > 400 and VBAT < 12V for > 30 sec.	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged
Stop Engine	1939- DM1 SA 00 GMLAN – TBD	As Shown		Red Stop Lamp	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Fault is gone
Low Coolant Level	1939- DM1 SA 00 GMLAN – TBD	As Shown		SPN 111_FMI 1, 11 or 18	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged
Hi Trans Temp	1939- DM1 SA 03 GMLAN – TBD	As Shown		SPN 177_FMI 15	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged
Low Oil Pressure	1939- DM1 SA 00 GMLAN – TBD	As Shown		SPN 100_FMI 1, 11 or 18	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged
Hi Engine Temp	1939- DM1 SA 00 GMLAN – TBD	As Shown		SPN 110_FMI 0, 11 or 16	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged

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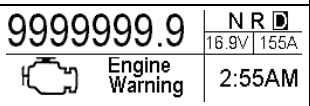
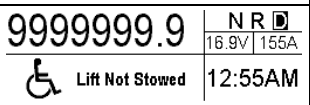
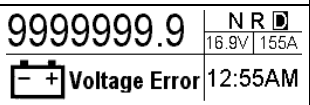
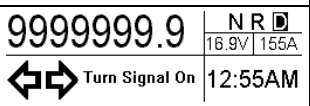
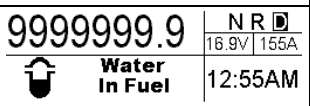
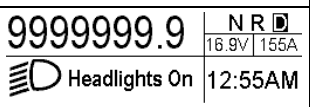
Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Engine Warning	1939- DM1 SA 00 GMLAN – TBD	As Shown		Amber Warning Lamp	Symbol flashing forward to reverse video at 500msec intervals	Continuous/ Until Acknowledged
Lift Not Stowed	CL_Pin_33	As Shown		Active Low	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 5 sec
Battery Voltage Error	J1939 – PGN65271_SPN 168 GMLAN – TBD	As Shown		On ≤ 11.0V for > 30 sec (then off at 12.1V) On ≥ 15.5V (then off at 15.3V)	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 5 sec
Turn Signal Warning	CL_Pin_21 or CL_Pin_23	As Shown		When vehicle travels 1 mile with either turn signal on but not both	Symbol flashing forward to reverse video at 500msec intervals	Beep 1
Water in Fuel	J1939 – PGN65279_SPN 97	As Shown		Value = 01	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/Until Acknowledged
Headlight Alert	CL_Pin_19	As Shown		Ignition is OFF and Headlights input is Active	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 2 min.

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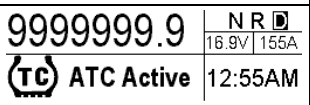
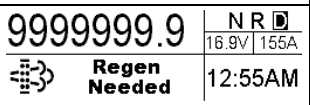
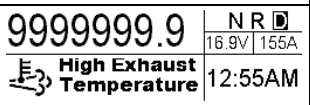
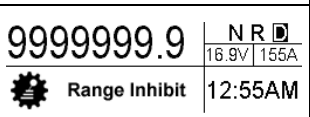
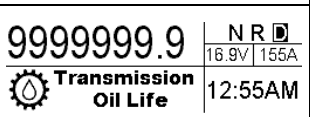
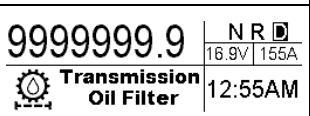
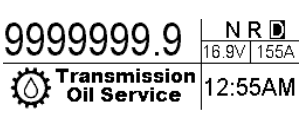
Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
ATC	J1939 – PGN61441_SPN 1793 GMLAN – TBD	As Shown		Value = 01	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 5 sec
DPF	J1939 – PGN64892_SPN3697	As Shown		000 = OFF 001 = ON 100 = Fast blink	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 5 sec
Hi Exhaust Temp	J1939 – PGN64892_SPN3698	As Shown		000 = OFF 001 = ON 100 = Fast blink	Symbol flashing forward to reverse video at 500msec intervals	Beep 1/for 5 sec
Range Inhibit	J1939 – PGN65098_SPN 1851 GMLAN – TBD	As Shown		Value = 01	Symbol flashing forward to reverse video at 500msec intervals	None
Trans Oil Life	J1939 – DM1 SA 03 GMLAN – TBD	As Shown		SPN 4177_FMI 17	Symbol flashing forward to reverse video at 500msec intervals	None
Trans Oil Filter	J1939 – DM1 SA 03 GMLAN – TBD	As Shown		SPN 3359_FMI 31	Symbol flashing forward to reverse video at 500msec intervals	None
Trans Oil Service	J1939 – DM1 SA 03	As Shown		SPN 4178_FMI 31	Symbol flashing forward to reverse video at 500msec intervals	None

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9.4.2.1. Brake Interlock Display Message Detail

The brake interlock Priority Interrupt Display message will function per logic below. This message is NOT acknowledgeable.

Air Brakes Systems w/ Brake interlock (40051-02)

Scenario	Vehicle Speed	Brake Interlock Alarm Input (CL PIN 27)	Brake Interlock Request Input (CL PIN 26)	Brake Interlock Set Input (CL PIN 35)	Cluster Behavior
1	≤ 3 MPH	N/A	ACTIVE	ACTIVE	PIM = BRAKE INTERLOCK SET ALARM = NONE
2	≤ 3 MPH	N/A	ACTIVE	INACTIVE	PIM = BRAKE INTERLOCK FAIL (flashing forward to reverse video at 500msec intervals) ALARM = Continuous 1 until fault is gone
3	> 3 MPH	N/A	ACTIVE	N/A	PIM = BRAKE INTERLOCK REQUESTED (flashing forward to reverse video at 500msec intervals) ALARM = Beep 2 on for 5 sec/off for 15 sec until fault is gone

Hydraulic Brakes Systems w/ Brake interlock (40051-01)

Scenario	Vehicle Speed	Brake Interlock Alarm Input (CL PIN 27)	Brake Interlock Request Input (CL PIN 26)	Brake Interlock Set Input (CL PIN 35)	Cluster Behavior
1	≤ 3 MPH	INACTIVE	ACTIVE	INACTIVE	PIM = BRAKE INTERLOCK SETTING (flashing forward to reverse video at 500msec intervals) ALARM = Beep 1 until fault is gone
2	≤ 3 MPH	INACTIVE	ACTIVE	ACTIVE	PIM = BRAKE INTERLOCK SET ALARM = Beep 2 for 2 sec
3	≤ 3 MPH	ACTIVE	ACTIVE	INACTIVE	PIM = BRAKE INTERLOCK FAIL (flashing forward to reverse video at 500msec intervals) ALARM = Continuous 1 until fault is gone
4	> 3 MPH	N/A	ACTIVE	N/A	PIM = BRAKE INTERLOCK REQUESTED (flashing forward to reverse video at 500msec intervals) ALARM = Beep 2 on for 5 sec/off for 15 sec until fault is gone

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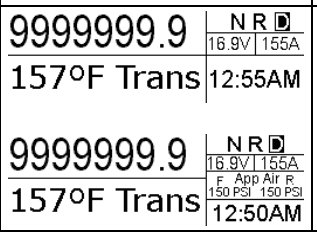
9.5. Quadrant 4

Quadrant 4 is dedicated to the clock. If Applied Air or Suspension Air feature is active, Quad 4 is 80x15. If no air features are active then the Quad 4 is 80x23. Quad 4 can be toggled between 12 and 24 hour mode settings. To do this you must first press and release the bottom button to activate quad 3, and then press and release both buttons simultaneously which will highlight quad 4 in reverse video and allow you to toggle between the 2 modes by pressing and releasing the top or button.

Function	**Data Source**	**Text Format**	**Display Example**	**Trigger Logic**	Display Notes	**Alarm/ Duration**
Clock	Internal clock crystal	XX:XX AM			When clock is highlighted pressing & holding the ***m & t*** buttons changes from 12 to 24 hour mode	

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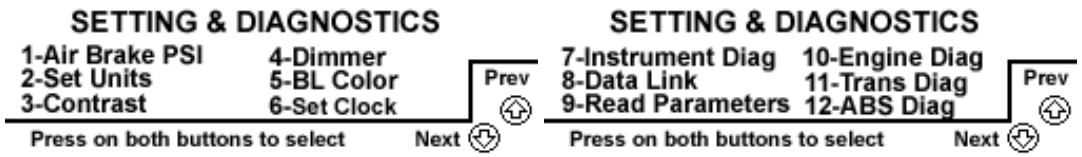
10. SETTINGS AND DIAGNOSTIC

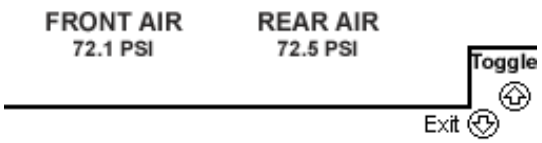
This menu allows the user to change certain features from their default settings and to use diagnostics to trouble shoot the instrumentation. Access this menu by setting the park brake and then from the Drive Mode Screen press the ***lower*** button for >5 seconds.



The item highlighted in **reverse video** will be selected when both of the buttons are pressed together. Pressing either button separately will move the highlight through the list, as indicated by the arrow, so other items can be selected. This menu will auto exit to the drive screen after 10 sec timeout with no activity.

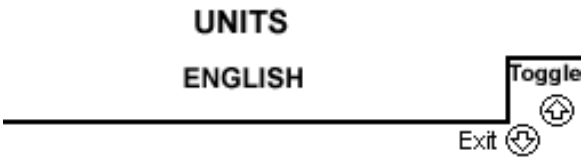
10.1. Air Brake PSI

Selecting menu item 1 brings up the following screen that is used to perform Pre-trip Brake Inspections. It will show Front and Rear brake system PSI. Pressing the down button will exit to the previous screen.



10.2. Set Units

Selecting menu item 2 brings up the following screen that is used to select if values are to be displayed in Metric units or English units. This will change the Speedo reading and units lamp, display/menu items except Air which will always be displayed as PSI, and change which brake system fail lamp is used. Pressing the down button will exit to the previous screen.



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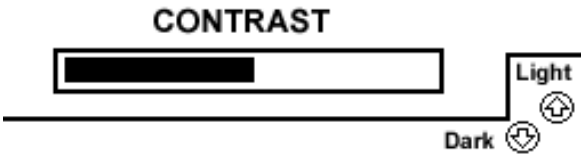
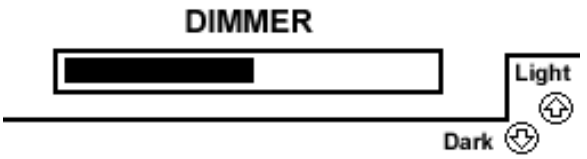
10.3. Contrast

Selecting menu item 3 displays a screen to allow setting the LCD contrast. Pressing the ***lower*** button will increase contrast while pressing the ***upper*** button will decrease contrast. This menu will auto exit to the previous screen after 10 sec timeout with no activity.



10.4. Dimmer

Selecting menu item 4 displays a screen to allow setting the cluster backlighting brightness. Pressing the ***lower*** button will decrease brightness while pressing the ***upper*** button will increase it. This menu will auto exit to the previous screen after 10 sec timeout with no activity.



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10.5. Backlight color

Selecting menu item 5 displays a screen to allow setting the cluster backlighting color. Pressing the buttons will toggle between a list of preset colors.

10.6. Set Clock

Selecting menu item 6 allows the user to set the clock. Pressing both buttons will first select the "hours" selection and it will be highlighted. Subsequent presses of both the buttons will select minutes and the AM / PM selections. Once any selection is highlighted, then the ***lower*** buttons will decrease the setting and the ***upper*** button will increment the setting. Once all three selections have been selected this menu will timeout to the previous menu after 15 seconds unless the operator enters back into any of the selections.

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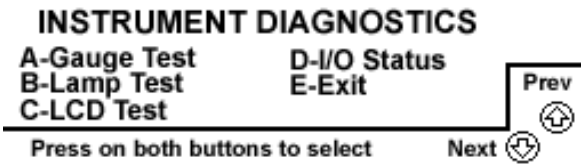
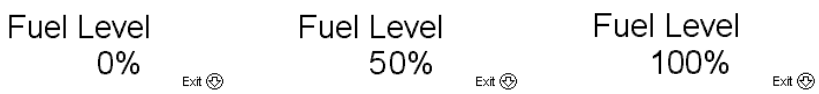
10.7. Instrument Diagnostics

Selecting menu item 7 in the Settings and Diagnostic Menu will display the instrument diagnostic menu.



10.7.1. GAUGE TEST

Item A - The selected gauge will be driven through three positions pausing at each position as shown in the LCD as a percentage of scale. This test will proceed through all gauges and return to the menu. Pressing the ***lower*** button (Exit) will end the test and return to the previous menu.



10.7.2. LAMP TEST

Item B - Turns each IP warning lamp (not the vehicle load) on then off displaying the lamp name and status in the LCD. This test goes through all warning lamps and then returns to the menu. Pressing the ***lower*** button (Exit) will end the test and return to the previous menu. (High beam test shown as an example)

10.7.3. LCD TEST

Item C – Displays the Bluebird logo in normal and reverse video three times and then return to the previous menu. Pressing the ***lower*** button will end the test and return to the previous menu.

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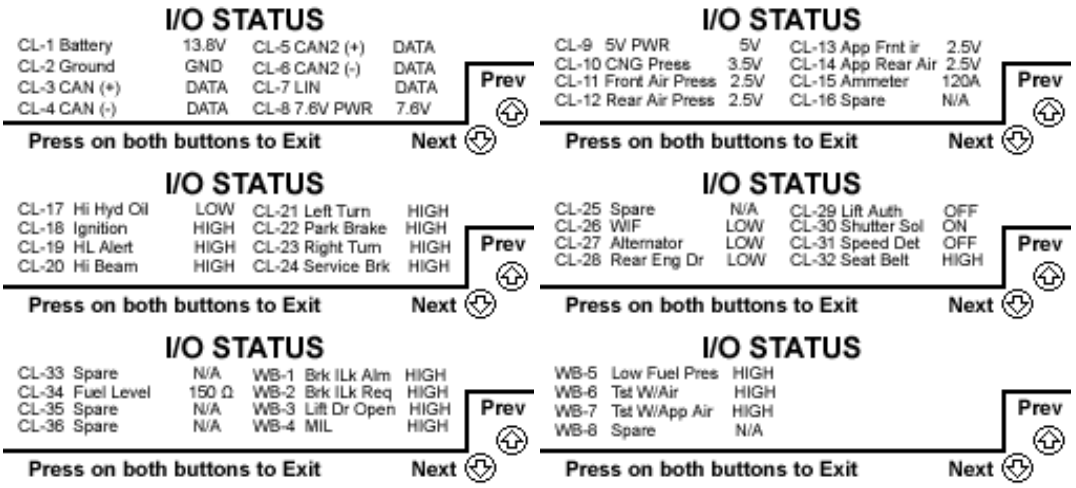
10.7.4. I/O STATUS

Item D – Displays the module-pin number, and the status as received by the vehicle's electrical system. Scroll through all the status screen by screen using the up and down arrows. Press both buttons to exit to the previous screen. (screens shown for reference only, actual inputs may differ)



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Note: The value "high" and "low" refers to the voltage level at the connector pin for binary inputs. Warning bank information will only be shown if warning bank is detected on the LIN data bus. This information will be continuously updated to assist in troubleshooting

10.7.5. I/O STATUS

Item E – Exits from this menu to the previous screen.

10.8. Data Link

Item 8– The LIN will be checked and each device found on that data bus would be displayed. If the device is saved automatically in this list and is disconnected from the system a warning will be displayed. You can delete the device from this list to avoid this warning by scrolling to the device in the list and pressing both buttons. Once removed, the cluster will not display a warning unless the device is reconnected and auto saved back to the list. Press the Exit button to exit to the previous screen.

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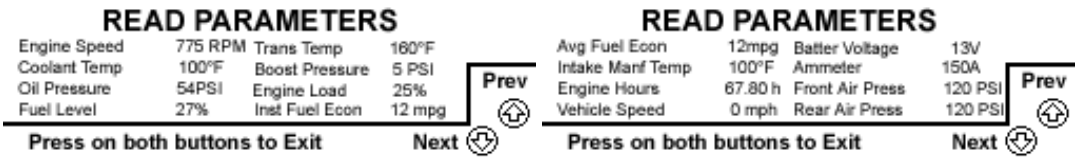
10.9. Read Parameters

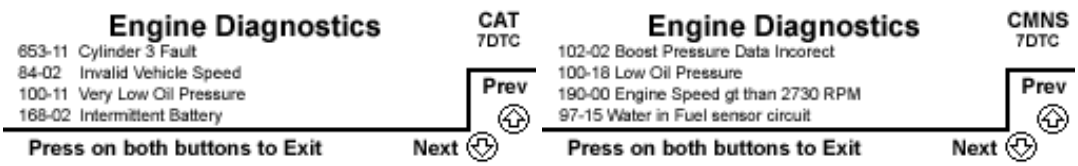
Item 9 – Displays all of the converted values for the applications parameters in a table form for vehicle troubleshooting. You can scroll though to view them and press both buttons to exit to the previous screen.



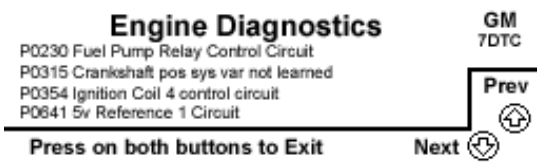
10.10. Engine Diagnostic

Item 10- Displays engine DTC's in a format dependant on engine type. Engine type and number of active DTC's is located in upper right corner. Press both buttons to exit to previous screen.

CAT/Cummins
This screen displays the Suspect Parameter Number (SPN) and Failure mode Identifier (FMI) as received from the engine for active faults via J1939 (Active faults shown below as examples)



GM
This screen displays the J2012 DTC Display as received from the engine for active faults via 1939 (Converted from 1850)/GMLAN (Active faults shown below as examples)



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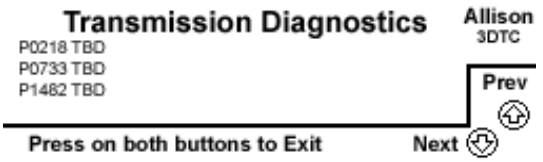
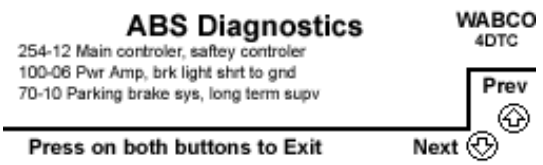
10.11. Trans Diagnostic

Item 11- This screen displays J2012 DTC Display as received from the transmission for active faults via J1939 (Active faults shown below as examples). Transmission type and number of active DTC's is located in upper right corner. Press both buttons to exit to previous screen.



10.12. ABS Diagnostic

Item 12-ABS Diagnostics – This screen displays the Suspect Parameter Number (SPN) and Failure mode Identifier (FMI) as received from the ABS for active faults via J1939. (Two active faults shown below as an example). Brake system type and number of active DTC's is located in upper right corner. Press both buttons to exit to previous screen.



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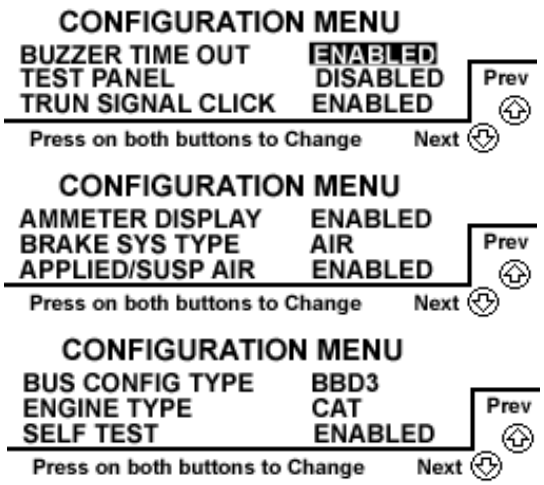
11. CONFIGURATION MENU

Holding both buttons pressed while turning the ignition on enters the Configuration Menu. In this menu configurable features can be enabled and disabled. If the cluster has logged less than 25 mi, all menu selections can be changed using the buttons. After 25 mi some items will only be able to be modified using a Diagnostic tool via PC or other diagnostic interface that can communicate with the cluster on the diagnostic layer.

To change a feature configuration with the buttons scroll up or down to it and then press both buttons to change the config. After 25 mi, you will be able to see all menu items but only change the items that are USER CONFIGURABLE (see the feature config tables for this info). The rest will require the diagnostic tool after 25 mi. This menu will auto exit and the cluster will re-initialize its startup routine after 10 sec timeout with no activity.



The default value of these settings is defined on the assembly line print and set on the line per part number.

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11.1. Buzzer Time out Enable

When this configuration is ENABLED the continuous 1 audible alarm (Buzzer) would be allowed to timeout in 15 sec if the engine speed is < 400 RPM. When this configuration is DISABLED the continuous audible alarm will not time out.

11.2. Test Panel

When this configuration is ENABLED the cluster is set as a manufacturing tool for the chassis test fixture and the software will ignore the internal configuration for BRAKE SYS TYPE and APPLIED/SUSP AIR. It will instead receive this configuration information from the optional input module binary inputs (See section 12.8). When this configuration is DISABLED the cluster is set as a normal production part and will use the internal configuration to determine BRAKE SYS TYPE and the presence of APPLIED or SUSPENSION AIR. This feature is displayed in this menu but can only be changed using a VCI and ACTIA provided software.

11.3. Turn Signal Click

When this configuration is ENABLED the turn signal will use the simulated relay click audible sound. When this configuration is DISABLED there will be no sound for turn signal.

11.4. Ammeter Display

When this configuration is ENABLED the Ammeter value is shown in the display beside the Voltmeter (See section 7.1). When this configuration is DISABLED only the Voltmeter is shown.

11.5. Brake System Type

When this configuration is set to AIR, the software is configured to use the Front and Rear Air inputs to display the front and rear air pressure on the appropriate gauges. When configured as HYD the software will not drive these gauges and will use the Front Air input to determine Suspension Air Pressure. This setting will also effect how the Brake Interlock PIM logic works (section 9.4.2.1)

11.6. Applied/Suspension Air

When this configuration is ENABLED the software is configured to display Applied Front and Rear Air Pressure (for Air Brake System) or Suspension Air (for Hydraulic Brake System) depending on Brake System Type Configuration. When DISABLEED Applied air/Suspension air are NOT displayed (See section 7.1).

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11.7. Bus Configuration Type

The cluster can be configured to be used on one of two product lines, BBD3 or BBCV. This setting will effect the binary logic for Park Brake and Fast Idle inputs. They will be as follows:

Input	BBD3	BBCV
Park Brake	AL	AH
Fast Idle	AH	AL

11.8. Engine Configuration Type

This configuration is set by internal logic based on Engine ID's broadcast on the data bus. This will effect what messages are sent for Throttle Interlock and Fast Idle functions (section 8.6). It may also effect what Parameters are available to display in Quad 3 on the LCD (section 9.4.1).

11.9. Self Test

When this configuration is ENABLED the cluster will perform a startup self test at Ignition (See section 4.2.1) When the configuration is the cluster will not perform a startup self test.

11.10. Battery Controlled Lift

When this configuration enabled it affects the logic of several of the outputs. See section 7 for details.

11.11. Seatbelt Logic

When this configuration is ENABLED the Seatbelt Logic for the alarm and lamp detailed in section 5.4.1 will apply. If it is DISABLED this logic will not apply. No alarm or lamp will be triggered if this is the case. When disabled, if the seatbelt input is pulled low, this will automatically enable the configuration.

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12. FEATURE PROGRAMMING

The following table shows the bit address for the configurable features. These will be set by Manf. depending on the configuration that is built. Some of these can be configured through the diag menu as shown above. The default value for manf. to set will be defined on the family print 111027 per part number.

12.1. Byte 0

Feature	Bit Address	Value	User Configurable after 25 mi.
Buzzer Timeout Enable	Bit 0	0=OFF 1=ON	YES
Test Panel Enable	Bit 1	0=OFF 1=ON	NO
Turn signal click Enable	Bit 2	0=OFF 1=ON	YES
Ammeter Enable	Bit 3	0=OFF 1=ON	YES
Brake System Type	Bit 4	0=Air (Bendix) 1=Hydraulic (WABCO)	NO
Applied Air/Suspension Air Enable (If bit 4 is set to Air this option effects Applied Air/If it is set to Hydraulic it effects the Suspension air feature)	Bit 5	0=Disabled (OFF) 1=Enabled (ON)	YES
Buss Type	Bit 6	0=BBD3 1=BBCV	NO
Clock Mode	Bit 7	0= 12 hrs mode 1= 24 hrs mode	YES

12.2. Byte 1

Feature	Bit Address	Value	User Configurable after 25 mi.
Engine Type	Bit 0 Bit 1 Bit 2 Bit 3	0001 = Cummins ISB07 (1939) 0010 = Cummins ISC07 (1939 0011 = Cummins ISLG07 (1939) 0100 = CAT Diesel C7 (1939) 0101 = GM Gas(1850) 0110 = GM Gas (GMLAN) 0111 = Cummins OTHER 1000 = CAT OTHER	NO
Battery Controlled Lift Option	Bit 4	0=Disabled (OFF) 1=Enabled (ON)	NO
ABS Type	Bit 5	0= WABCO 1=Bendix	NO
Trans Type	Bit 6	0=Allison 1=Other	NO
Seat Belt Logic	Bit 7	0=Disabled 1=Enabled	NO

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12.3. Diagnostic Commands

The following table shows the possible feature values for diagnostic commanded features set by manf. by specific command or by enabling defaults set in the application code. The default value for manf. to set will be defined on the family print 111027 per part number.

Feature	Command Configured Value	Application Default Setting	User Configurable after 25 mi.
Service Gauge	YES/NO	N/A—Manf Set per print	NO
Self Test	ON/OFF	N/A—Manf Set per print	YES
Display Units (Metric/US)	METRIC/US	N/A—Manf Set per print	YES
Dimmer	0-100%	100%	YES
Contrast	0-100%	50%	YES
Engine Hrs	XXXX Hrs	0 hrs	NO
Trip 1	XXXXXXX.X mi	0 mi	YES
Trip 2	XXXXXXX.X mi	0 mi	YES
Odometer Reference		0	NO
Active LIN device		0	YES
Data link warning		0	YES
Backlight Color	Blue, Lt Blue, White, Red, Green	Green	YES
Device ID			NO
Wakeup			NO

13. RELATED STANDARDS

SAE J1455 *Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy-Duty Trucks)*
SAE J1211 *Recommended Environmental Practices for Electronic Equipment Design*
*SAE J1113/** *Electromagnetic Compatibility Measurement Procedures and Limits for Vehicle Components*
SAE J1812 *Function Performance Status Classification for EMC Immunity Testing*
SAE J2217 *Photometric Guidelines for Instrument Panel Displays that Accommodate Older Drivers*
SAE J1939 *Recommended Practice for Truck and Bus Control and Communications Network*
SAE J1708 *Serial Data Communications Between Microcomputer Systems*
SAE J1587 *Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications*
SAE J1226 *Electric Speedometer Specification – On Road*
SAE J1399 *Electric Tachometer Specification*
SAE J1810 *Electrical Indicating System Specification*
SAE J1048 *Symbols for Motor Vehicles Controls, Indicators and Tell-Tales*
SAE J1362 *Graphical Symbols for Operator Controls and Displays on Off-Road Self-Propelled Work Machines*
FMVSS 302 *Flammability of interior materials*
LIN Specification Package Revision 1.2
ELECSP13 *Bluebird Engineering Standard - Electrical environmental specification*
FMVSS/CMVSS 101
FMVSS/CMVSS 105
FMVSS/CMVSS 135
GMW3097
GMW3172

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14. GLOSSARY/ABBREVIATIONS

TBD – To be determined
EEPROM – Electrically Erasable Programmable Read Only Memory
SAE – Society of Automotive Engineers
PGN – Parameter Group Number (J1939)
SPN – Suspect Parameter Number (J1939)
FMI – Failure Mode Identifier (J1939)

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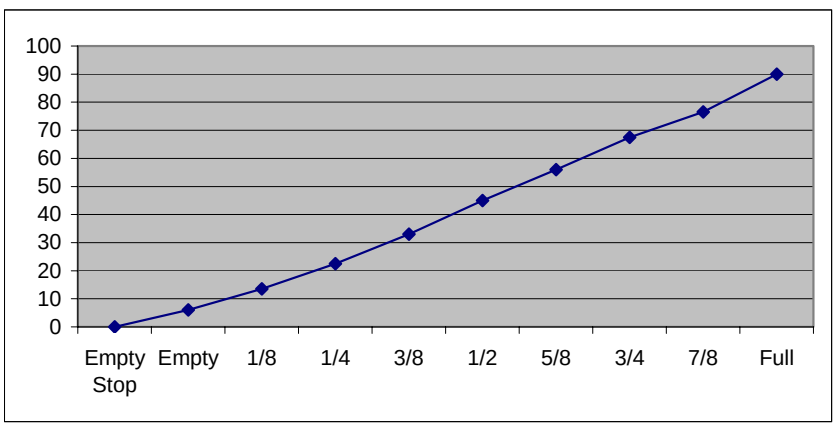
Resistive Fuel Sender

Type **Resistive Fuel Sender**
Manufacturer **?????????**
Mftr part#

Indication	Minimum	Nominal	Maximum
Empty Stop	0	0	0
Empty	3	6	9
1/8	10.5	13.5	16.5
1/4	19.5	22.5	25.5
3/8	30	33	36
1/2	42	45	48
5/8	53	56	59
3/4	64.5	67.5	70.5
7/8	73.5	76.5	79.5
Full	87	90	93



Note:
If the sender is over 180 ohms the system will assume that it is a **"out of tolerance"** sender and the fuel level gauge will display a fault by wagging.

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14.1. Voltage Fuel Sender

Voutput = (PSI*(4/3600))+1

Type: Pressure Transducer
Manufacturer: Energy Kinetic
Mfg part# EK-110-1S-36C
0-3600PSI = 1 – 5 V

Energy Kinetic Pressure Sender				**Voltage**							
Pressure(PSI)	Voltage(V)	Expected V	Error	Pressure(PSI)	Voltage(V)	Expected V	Error	Pressure(PSI)	Voltage(V)	Expected V	Error
100	1.154	1.111	3.860%	1100	2.223	2.222	0.035%	2600	3.925	3.889	0.929%
125	1.186	1.139	4.137%	1200	2.336	2.333	0.114%	2700	4.042	4.000	1.050%
150	1.218	1.167	4.400%	1300	2.485	2.444	1.659%	2800	4.170	4.111	1.432%
175	1.247	1.194	4.400%	1400	2.610	2.556	2.130%	2900	4.200	4.222	0.526%
200	1.278	1.222	4.564%	1500	2.663	2.667	0.138%	3000	4.370	4.333	0.846%
225	1.304	1.250	4.320%	1600	2.829	2.778	1.844%	3100	4.490	4.444	1.025%
250	1.335	1.278	4.478%	1700	2.945	2.889	1.942%	3200	4.600	4.556	0.976%
300	1.394	1.333	4.550%	1800	3.055	3.000	1.833%	3300	4.710	4.667	0.929%
400	1.498	1.444	3.708%	1900	3.171	3.111	1.925%	3400	4.810	4.778	0.674%
500	1.600	1.556	2.857%	2000	3.265	3.222	1.328%	3500	4.900	4.889	0.227%
600	1.711	1.667	2.660%	2100	3.393	3.333	1.790%	3600	5.000	5.000	0.000%
700	1.769	1.778	0.494%	2200	3.481	3.444	1.061%				
800	1.896	1.889	0.376%	2300	3.605	3.556	1.391%				
900	2.056	2.000	2.800%	2400	3.725	3.667	1.591%				
1000	2.159	2.111	2.268%	2500	3.815	3.778	0.985%				

4.5% error = 162 psi for a 3600 psi transducer

664

Indication	Nominal PSI
Empty	260
1/8	665
1/4	1070
3/8	1475
1/2	1880
5/8	2285
3/4	2690
7/8	3095
Full	3500

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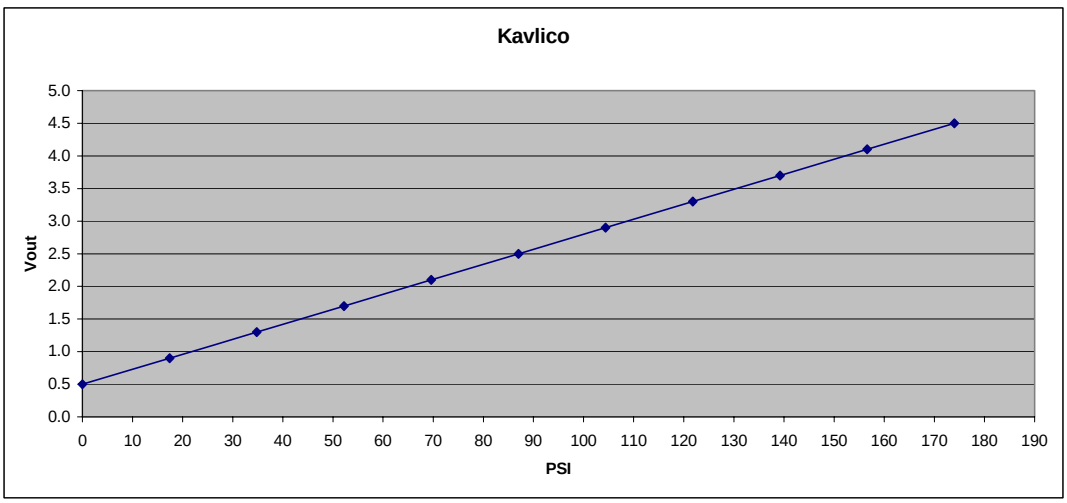
14.2. Air Pressure Sensors

14.2.1. 174 PSI

Kavlico P2000-5192	
Psi	voltage
0	0.50
17.4	0.90
34.8	1.30
52.2	1.70
69.6	2.10
87	2.50
104.4	2.90
121.8	3.30
139.2	3.70
156.6	4.10
174	4.50



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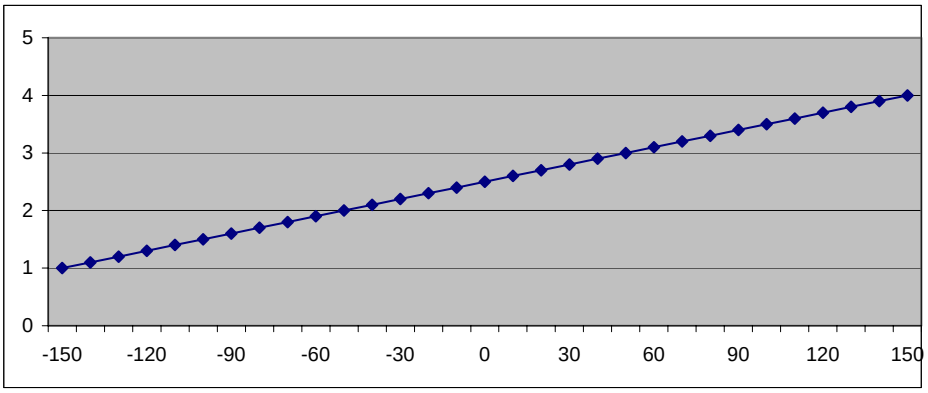
14.3. Ammeter

Type **Ammeter Hall Effect Sensor**
Manufacturer **Sure Power**
Mftr part# DCCS45S-200

Indication (Amps)	Minimum (V)	Nominal (V)	Maximum (V)
-150	0.9900	1	1.0100
-140	1.0890	1.1	1.1110
-130	1.1880	1.2	1.2120
-120	1.2870	1.3	1.3130
-110	1.3860	1.4	1.4140
-100	1.4850	1.5	1.5150
-90	1.5840	1.6	1.6160
-80	1.6830	1.7	1.7170
-70	1.7820	1.8	1.8180
-60	1.8810	1.9	1.9190
-50	1.9800	2	2.0200
-40	2.0790	2.1	2.1210
-30	2.1780	2.2	2.2220
-20	2.2770	2.3	2.3230
-10	2.3760	2.4	2.4240
0	2.4750	2.5	2.5250
10	2.5740	2.6	2.6260
20	2.6730	2.7	2.7270
30	2.7720	2.8	2.8280
40	2.8710	2.9	2.9290
50	2.9700	3	3.0300
60	3.0690	3.1	3.1310
70	3.1680	3.2	3.2320
80	3.2670	3.3	3.3330
90	3.3660	3.4	3.4340
100	3.4650	3.5	3.5350
110	3.5640	3.6	3.6360
120	3.6630	3.7	3.7370
130	3.7620	3.8	3.8380
140	3.8610	3.9	3.9390
150	3.9600	4	4.0400



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14.4. J1939 Table of Messages

Frame	PGN	Name	Byte	TX/RX	English / Metric Units	Source Address
Engine Hours	65,253 (00FEE5)	Total engine hours	1,2,3,4	RQ	H	0
Component ID	65,259 (00FEEB)	Component ID	Multipacket	RQ		0
Cruise Control/Vehicle Speed	65,265 (00FEF1)	Wheel-based vehicle speed	2,3	RX	MPH/ km/h	0
Cruise Control/Vehicle Speed	65,265 (00FEF1)	Service Brake	4 b 6&5	TX		17
Cruise Control/Vehicle Speed	65,265 (00FEF1)	Park Brake	1 b 4&3	TX		17
PTO	65,264 (00FEF0)	Throttle Interlock (CAT)	6 b 2&1	TX		17
PTO	65,264 (00FEF0)	Engine PTO Governor enable switch	6 b 2&1	TX		17
PTO	65,264 (00FEF0)	Engine Remote PTO Governor Programmed Speed Control Switch	6 b 4&3	TX		17
EBC1	61,441 (00F001)	Throttle Interlock (Cummins)	4 b 2&1	TX		17
EBC1	61,441 (00F001)	ABS	6 b 6&5	RX		0B
EBC1	61,441 (00F001)	ATC	6 b 8&7	RX		0B
Shutdown	65,252 (00FEE4)	Wait to Start	4 b 2&1	RX		0
DM1	65,226 (00FECA)	Active DTC	3-6	RX		0
DM1	65,226 (00FECA)	Protect lamp	1 b 2&1	RX		0
DM1	65,226 (00FECA)	Amber warning lamp	1 b 4&3	RX		0
DM1	65,226 (00FECA)	Red Stop lamp	1 b 6&5	RX		0
Shutdown	65,252 (00FEE4)	Idle Shutdown Active (SPN 594)	1 b 4&3	RX		0
EEC1	61,444 (00F004)	Engine speed	4,5	RX	RPM	0
EEC2	61,443 (00F003)	Percent load	3	RX	%	0
Engine Fluid Level/Pressure	65,263 (00FEEF)	Engine oil pressure	4	RX	PSI/ KPa	0
Engine Temperature	65,262 (00FEEE)	Engine coolant temp.	1	RX	°F / °C	0
ERC1	61,440 (00F000)	Retarder	4 b 4&3	RX		0F or 10 or 29
ETC1	61,442 (00F002)	Electronic Trans. Controller	N/A	RX		3
ETC7	65,098 (00FE4A)	Shift inhibit	2 b 8&7	RX		3
Fuel Economy	65,266 (00FEF2)	Instantaneous fuel econ	3,4	RX	MPG/ L/100Km	0
Fuel Economy	65,266 (00FEF2)	Average fuel economy	5,6	RX	MPG/ L/100Km	0
Inlet/Exhaust Conditions	65,270 (00FEF6)	Boost pressure	2	RX	PSI/ KPa	0
Inlet/Exhaust Conditions	65,270 (00FEF6)	Intake manifold temperature	3	RX	°F / °C	0
Transmission Fluids	65,272 (00FEF8)	Transmission oil temp.	5,6	RX	°F / °C	3
ETC2	61,445 (00F005)	Transmission Current Gear 7Dh = neutral; ≤7Ch = reverse, 7Eh though 84h = drive	4	RX		3
Vehicle Electrical Power	65,271 (00FEF7)	Electrical potential (volts)	5,6	RX	V	0
Vehicle Electrical Power	65,271 (00FEF7)	Battery potential (volts) Switched	7,8	RX	V	0
Dash Display	65,276 (00FEFC)	Fuel Level	2	RX	%	0
WFI	65,279 (00FEFF)	Water in fuel	1 b 2&1	RX		0
PTC1	64,892 (00FD7C)	Particulate Trap Lamp Command	1 b 1-3	RX		0
PTC1	64,892 (00FD7C)	Exhaust System High Temp	7 b 3-5	RX		0
Cruise Control/Vehicle Speed	65,265 (00FEF1)/SPN 527	Cruise Control State	7B, 8, 7, 6	RX		0
Defined Faults	**PGN**	**Name**	**Byte**	**SPN**	**FMI**	**Source Address**
DM1	65,226 (00FECA)	High Coolant Temp	3-6	110	0, 11 and 16	0
DM1	65,226 (00FECA)	Low Oil Pressure	3-6	100	1, 11 and 18	0
DM1	65,226 (00FECA)	Amber warning light/Check Transmission	1 b 4&3 3-6	2003	31	3
DM1	65,226 (00FECA)	High Trans Temperature	1 b 4&3 3-6	177	15	3
DM1	65,226 (00FECA)	Low Coolant Level	3-6	111	1, 11 and 18	0
DM1	65,226 (00FECA)	Trans Fluid Filter	3,4,5	3359	31	3

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DM1	65,226 (00FECA)	Trans Fluid Life	3,4,5	4177	17	3
DM1	65,226 (00FECA)	Trans Service	3,4,5	4178	31	3

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14.5. GM LAN Tabel

TBD

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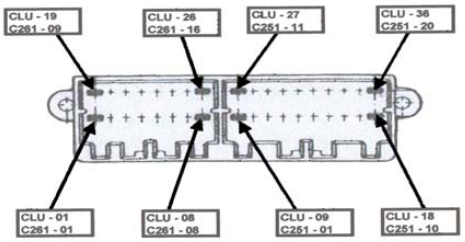
14.6. Cluster Connector



Term (CLU)	Term (C261/251)	Designation	Wakeup Hardware/ Software	Description
1	C261 01	Battery		Unswitched positive (+) 14V
2	C261 02	Ground		Chassis ground
3	C261 03	CAN+	S	SAE J1939 Databus
4	C261 04	CAN-	S	SAE J1939 Databus
5	C261 05	CAN+	S	SAE GMLAN Databus
6	C261 06	CAN-	S	SAE GMLAN Databus
7	C261 07	LIN		LIN Databus
8	C261 08	+7.6V Power		Slave device power output [800ma max current draw]
9	C251 01	+5 Vdc		Regulated +5Vdc Sensor Power [50ma max current draw]
10	C251 02	CNG Fuel Pressure Sender	S	VAI 1-5V [*Software Configurable VAI 0-7V*]
11	C251 03	Front Air Pressure Sender/Suspension Air	S	VAI 0.5-4.5V [*Software Configurable VAI 0-7V*]
12	C251 04	Rear Air Pressure Sender	S	VAI 0.5-4.5V [*Software Configurable VAI 0-7V*]
13	C251 05	Applied Front Air Pressure Sender	S	VAI 0.5-4.5V [*Software Configurable VAI 0-7V*]
14	C251 06	Applied Rear Air Pressure Sender	S	VAI 0.5-4.5V [*Software Configurable VAI 0-7V*]
15	C251 07	Ammeter	S	VAI 1-4V [*Software Configurable VAI 0-7V*]
16	C251 08	Spare		VAI 0-18V [*Software Configurable VAI 0-18V*]
17	C251 09	Hydraulic Brake Failure	S	BIN AL [*Software Configurable RAI*]
18	C251 10	Ignition	S	Binary Input - Active High
19	C261 09	Headlight Alert/Backlight On	S	BIN AH [*Software Configurable BIN AL/AH/RAI*]
20	C261 10	Hi Beam	S	BIN AH [*Software Configurable BIN AL/AH/RAI*]
21	C261 11	Left Turn	S	BIN AH [*Software Configurable BIN AL/AH/RAI*]
22	C261 12	Park Brake	S	See Buss Type Config [*Software Configurable BIN AL/AH/RAI*]
23	C261 13	Right Turn	S	BIN AH [*Software Configurable BIN AL/AH/RAI*]
24	C261 14	Service Brake Status	S	BIN AH [*Software Configurable BIN AL/AH/RAI*]
25	C261 15	Fast Idle	S	See Buss Type Config [*Software Configurable BIN AL/AH/RAI*]
26	C251 16	Brake Interlock Request	S	BIN AL [*Software Configurable RAI*]
27	C251 11	Brake Interlock Alarm	S	BIN AL [*Software Configurable RAI*]
28	C251 12	Rear Engine Door	S	BIN AL [*Software Configurable RAI*]
29	C251 13	Lift Authorize		BINOUT 1 - Active Low (1A max current draw – Sink)
30	C251 14	Shutter Solenoid		BINOUT 2 - Active Low (1A max current draw – Sink)
31	C251 15	Speed Detect Out		BINOUT 3 - Active Low (1A max current draw - Sink)
32	C251 16	Seat Belt	S	BIN AL [*Software Configurable RAI/FREQ*]
33	C251 17	Lift Door Open/Not stowed	S	BIN AL [*Software Configurable RAI/FREQ*]
34	C251 18	Fuel Level Sender		Binary Input - Active Low/RAI 0-400 Ohms (See Chart)
35	C251 19	Brake Interlock Set (AIR)/Lock (Hyd)		Binary Input - Active Low/RAI 0-400 Ohms
36	C251 20	Wait to Start		Binary Input - Active Low/RAI 0-400 Ohms

Signal low = Chassis Ground (0.0V – 1.5V) Signal high = 4.0V up to Ignition Voltage

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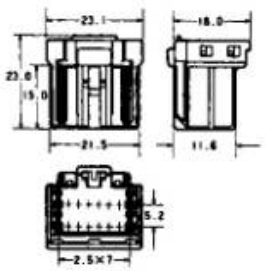
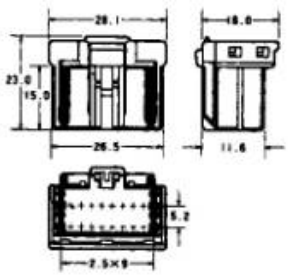
14.7. Cluster Mating Connectors

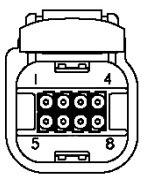
16 positions (2 X 8) (Actia P/N 102130)
Tyco US Part Number: 175966-2



20 positions (2 X 10) (Actia P/N 102131)
Tyco US Part Number: 175967-2



14.8. Warning Module Binary Input connector



8 positions (2 X 4) (Actia P/N 100950)
Tyco US Part Number: 1411001-1
LIN ID=0x92

Terminal	Designation	Description
1	Spare	Binary Input - Active low
2	Spare	Binary Input - Active low
3	Spare	Binary Input - Active low
4	Spare	Binary Input - Active low
5	Spare	Binary Input - Active low
6	Test Panel w/Air System	Binary Input - Active low
7	Test Panel w/Applied Air	Binary Input - Active low
8	Spare	Binary Input - Active low

Signal low = Chassis Ground (0.0V – 1.5V)
Signal high = 4.0V up to Ignition Voltage

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14.9. 1850 Gateway Module

Tyco GET64 series sealed connector.
8 positions (2 X 4) (Actia P/N 100950)
Tyco US Part Number: 1411001-1

.

Terminal	Designation	Description
1	Battery	**Unswitched positive (+)**
2	Ground	Chassis ground (-)
3	CAN+	SAE J1939 Data bus
4	CAN-	SAE J1939 Data bus
5	Switched Battery	Ignition input (wakeup)
6	Input 2	Multi Functional Input
7	Input 1	Multi Functional Input
8	J1850	SAE J1850 Data bus

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15. APPENDIX B

15.1. Service Set Odometer Feature --

Warning – U.S. Federal Law requires that the odometer accurately display the vehicle's actual mileage. It is the responsibility of the person installing the Cluster to make sure the mileage programmed into the odometer correctly matches the vehicle's actual mileage.

The Service Set feature allows the season odometer to be set by the service technician installing a new cluster into a vehicle. The odometer value is programmed using the front panel buttons and no other tools are necessary.

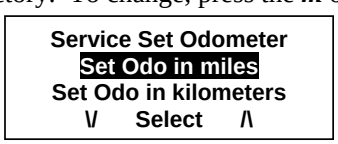
When the Cluster is powered up the LCD will display the fact that this is a Service Set Gauge and the odometer must be set. The Cluster will function in a limited mode until the Odometer has been set. Access to the set feature is controlled in the EEPROM and is secured using a four-byte code that prevents accidental access to this feature.

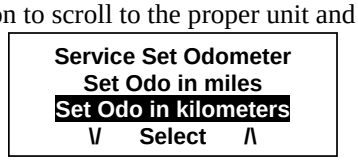
15.2. Limited Function

All gauge pointers will sit at zero position and not operate prior to setting the odometer while the LCD will only show the Service Set messages. All other parts of the system will operate. Warning icons located in the warning modules and in gauges will function normally and buzzer tones associated with the warnings will be allowed. Once set, the Service Set Gauge screen will not be seen again and the odometer value cannot be changed.

15.3. Setting the Units

Prior to setting the odometer value the technician must indicate to the gauge whether English (miles) or metric (kilometers) units are being set. The gauge will default to the unit that was set when the gauge left the factory. To change, press the ***m*** or ***t*** button to scroll to the proper unit and press both buttons to select.





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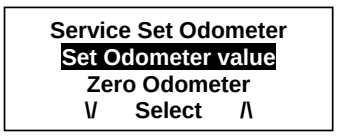
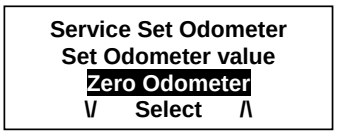
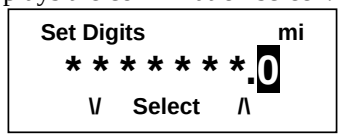
15.4. Setting the Odometer Value

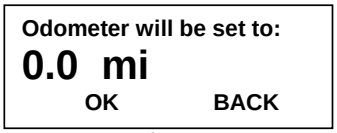
By using the ***m*** or ***t*** button to scroll you can highlight either Set Odometer Value or Zero Odometer.



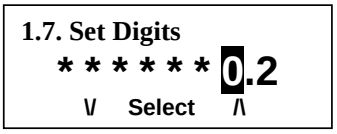


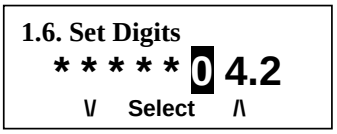
Selecting Set Odometer Value displays the Set Digits screen, while selecting Zero Odometer displays the confirmation screen.

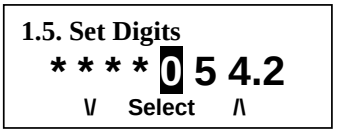


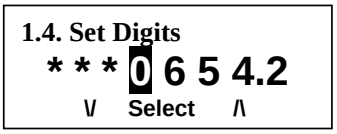


Each digit is set by using the ***m*** and ***t*** buttons to scroll forward and backward through the digits 0 – 9. Pressing ***m*** and ***t*** together stores the digit and displays the next digit to be set. The following screens show programming 7654.2 into the odometer.









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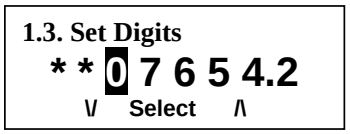
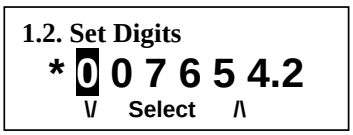
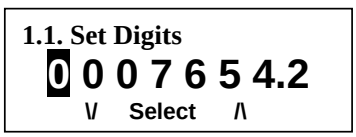
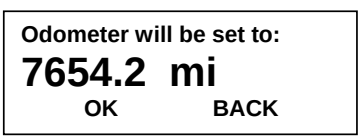
All digits must be set, but since pressing the ***m*** and ***t*** buttons together for select brings up the next digit as zero, you can quickly set the remaining digits to zero.







Once all digits have been set the confirmation screen will be displayed. Pressing ***m*** will accept the mileage while pressing ***t*** will take you back to the beginning Service Set Gauge screen to start over.



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